

**LINGUISTIC TRANSFER AND DIALECT LEVELLING:
A SOCIOPHONETIC ANALYSIS OF CONTACT IN THE
REGIONAL FRENCH OF BÉARN.**



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Spreag staid teagmhála teanga an-éagsúil an tráchtas seo: tá teanga dhúchais mo thír féin, an Ghaeilge, ag dul in éag faoi thionchar an Bhéarla ar feadh na gcéadta bliain. Ar bhealaí comhchosúla le siúd a thuairiscítear sa taighde seo, choinnigh an teagmháil seo gnéithe an Ghaeilge sa Bhéarla agus táimid in ann na rianta seo a chloistéail i mustar na bhfuaimnithe réigiúnacha áille atá i bhfeidhm ar fud na tíre. Tugann na blasanna seo ómós do na rudaí atá cailte againn, agus léiríonn sé, in ainneoin an phróisis aonclineálaigh forleathain seo, go bhfuil na hÉireannaigh, díreach ar nós na Béarnais, in ann a bhféiniúlacht atá fréamhaithe go domhain a choinneáil beo.

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ABSTRACT

LINGUISTIC TRANSFER AND DIALECT LEVELLING: A SOCIOPHONETIC ANALYSIS OF CONTACT IN THE REGIONAL FRENCH OF BÉARN.

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This thesis investigates the genesis and evolution of the regional variety of French spoken in Béarn, southwestern France, by considering phonetic and phonological changes taking place in two different contact situations: language contact between French and Béarnais, and dialect contact with other contemporary varieties of French. Through an examination of linguistic transfer, in a situation of bilingualism, and of levelling and diffusion during dialect contact, the thesis challenges two long-standing assumptions about regional French: that it results from ‘substrate residue’ and that this ‘residue’ is ephemeral and will therefore be lost over time. The methodology is sociophonetic, combining traditional Labovian data collection techniques with detailed acoustic phonetic analysis. The acoustic analyses focus on the mid-vowel and nasal unit systems of Béarnais and French, first examining L1-to-L2 transfer and subsequently investigating apparent-time changes taking place in regional French as a result of dialect contact. The findings show that, while this variety of regional French contains clear cases of ‘substrate residue’ from Béarnais, its formation during language contact is better accounted for by a combination of linguistic transfer, divergence and innovation, with structural correspondences between the surface phonologies of the languages influencing the outcomes of contact in each case, as predicted by Flege’s Speech Learning Model. The assumption that regional French features are transitory is refuted: the results of the apparent-time study show that young speakers in Béarn are not simply involved in the wholesale adoption of the northern French norm over time. Contemporary regional French in Béarn is shown to constitute a distinctive combination of local, supralocal and innovative features resulting primarily from the various mechanisms which constitute Kerswill’s model of Regional Dialect Levelling.

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INTRODUCTION

« Certains, pour se battre au service de la juste cause de l'antinationisme, pensent qu'il faut se précipiter vers la langue universelle, vers la transparence, vers l'effacement des différences. Je voudrais penser le contraire. »

(Jacques Derrida, *La langue n'appartient pas*, 2001)

The central aim of this thesis is to provide a systematic analysis of the genesis and evolution of a variety of language often referred to as *français régional* or regional French (RF): it analyses the emergence of RF in a situation of bilingualism as well as change taking place in the variety as a result of exposure to non-local varieties of French. Diatopic variation in contemporary varieties of French has received relatively little attention when compared with the large body of sociolinguistic literature on geographically-based variation and change in English and other languages. Crucially, no adequate theoretical analysis of RF exists and, with the exception of a small number of recent studies undertaken in the north of France, we have been left wondering about the precise origins and exact nature of these varieties.

1. REGIONAL FRENCH

Regional varieties of French are assumed to have resulted from contact between the national language and local varieties present in the regions before French was imposed: 'In the first half of the twentieth century, as French began to make significant inroads into areas of provincial France where it had not previously been spoken, new varieties emerged from contact between local and national norms'

(Hornsby, 2006:3). RF was first defined in this way by Dauzat: ‘Le français s’est d’abord implanté dans les centres urbains et dans les classes riches: modifié sous l’influence du milieu, il constitue ce que j’appellerai le français régional’ (1906:203). Hornsby (2006:3) notes, however, that a similar notion, defined as *français provincial* was advanced by Gilliéron some twenty years beforehand: ‘Le français provincial est le français importé dans les contrées où le langage indigène est un patois, français qui se développe selon ses propres germes et moyens de développement, et s’altère sous l’influence des patois’ (1886:290). The use of the term *français provincial* to mean *français régional* was common in the late nineteenth and early twentieth centuries but from 1940 onwards, *français régional* predominates. Tuaillon defines RF simply: ‘Par cette appellation commode, on a coutume de désigner l’ensemble des particularités géolinguistiques qui marquent les usages de la langue française, dans chacune des parties de la France et de la francophonie’ (1988:291). Despite this apparent interest in the definition of RF from as early as the nineteenth century, there exists to this day no full analytical account of how RF actually emerges from these contact situations. Indeed, Hornsby notes that the concept of *français régional* remains extremely ill-defined and poorly understood (2006:3).

While there has been a strong dialectological tradition in France since the nineteenth century (cf. *Atlas Linguistique de la France* (ALF) and other linguistic atlases¹), the linguistic documentation of regional variation has traditionally focused

¹ Gilliéron, J., and E. Edmont, E. 1912. *Atlas linguistique de la France* (Paris: Champion) and, for example, Gardette, P. 1950. *Atlas linguistique et ethnographique du Lyonnais* (Lyon: Institut de linguistique romane de facultés catholiques); Ségué, J., and J. Allières, 1973. *Atlas linguistique et ethnographique de la Gascogne* (Paris: CNRS); Patrice, B. 1980. *Atlas linguistique et ethnographique normand* (Paris: CNRS), etc.

on the regional languages and dialects of France and not on regional varieties of the French language: ‘Until the 1970s [...], dialectologists, some as eminent as Brun (1933) [*sic*], Dauzat (1935) [and] Séguy (1950) only occasionally afforded themselves the luxury of excursions into the realm of French regionalisms’ (Pooley, 2000:118). Arguably, this lack of RF in some of the earlier linguistic atlases was largely a function of the absence of proficient French speakers in rural areas until the period following the First World War. Indeed, in the ALF, French regionalisms were included if they were in use and no explicit line was drawn between what was or was not French (in terms of varieties). It is also possible, however, that the reluctance to single out RF as an object worthy of study in its own right was strongly linked to the long-standing ideologisation of French as a static, logical and pure variety of language: ‘ramasser des gasconismes², le projet pourra paraître bizzare. On observe, on recueille les bonnes choses; on néglige, on abandonne les mauvaises’ (Desgrouais, 1801:5). Jones notes that early comments on RF are both disparaging and prescriptive (2011:507), essentially designating geographical variation as a failed attempt to speak the standard language:

‘Il n’y a qu’un bon langage et [...] les manières vicieuses de s’exprimer sont incalculables. [...] Parce qu’il n’y a qu’un chemin qui mène à la vérité, et qu’il y en a mille qui conduisent à l’erreur.’

(Molard, 1810:10)

Molard’s description of RF as a collection of ‘phrases vicieuses’ may, again, be linked to some genuine lack of proficiency in French amongst rural populations in the nineteenth century: in a sense, some early varieties of RF may have been so heavily influenced by local languages that they were not readily recognisable as French. These derogatory definitions of RF continue, however, throughout the

² ‘Gasconismes’ was often used to denote solecisms in general, in addition to its more literal meaning: ‘Tour, mot gascon employé en français’ (*Le nouveau Petit Robert de la langue française*, 2009).

nineteenth and twentieth centuries, even after the advent of French into rural areas of France:

‘Le monde des patois et des dialectes est fondé sur la tolérance et sur la liberté d’être de son village ; le monde du français est celui de la discipline linguistique sévère. Les régionalismes du français sont des manquements à cette discipline ; ils marquent les points où l’unification linguistique n’a pas encore atteint à la perfection.’

(Tuaillon, 1988:299)

Various definitions of RF that have been proposed and almost all of them agree that RF preserves features from local varieties with which it is/was in contact. Perhaps the most famous example of this is Tuaillon’s assertion that RF is ‘ce qui reste du dialecte quand le dialecte a disparu’ (1974:576). The idea of linguistic ‘residue’ in French from moribund substrate languages and dialects leads to the conception of RF as what Hornsby calls a ‘halfway house’ variety:

‘Ces langues expliquent les particularités des usages français dans les régions où elles sont parlées, elles ont des liens très étroits avec le français, mais quand on conserve dans son discours trop de traits de ces langues, on ne parle pas tout à fait en français.’

(Tuaillon, 1988:294)

‘un niveau supplémentaire, intermédiaire entre la langue régionale qu’ils parlaient et le français commun qu’ils voulaient parler.’

(Müller, 1985:58-59)

While it is clear that substrate influence has a role to play in the emergence of RF from contact, the exact mechanisms by which linguistic ‘residue’ from local languages may be preserved in RF have not yet been fully elaborated. The influence of the *patois* on RF is all too frequently adduced as a catch-all explanation for non-standard forms in the emergent variety of French. Indeed, even well-established variationist sociolinguists note, without question, that bilingualism results in the most readily identifiable varieties of RF: ‘the most highly differentiated varieties [of RF] are found in the speech of regional-language dominant bilinguals’ (Armstrong and Pooley, 2010:156). While there appears to be some truth in this, the linguistic

mechanisms which facilitate or inhibit linguistic transfer in situations of bilingualism have not yet been explored empirically with reference to RF.

Regional varieties of French are also said to have received little attention as they have been largely considered to be transitional ephemera and of little theoretical interest (Hornsby, 2006:4). There is a widespread perception, both historically and more recently, that regional variation in French is ‘unfocused’ and that homogenisation processes will eventually lead to its attrition:

‘C’est une langue de nature éphémère, inconsistante, individuelle, et dont l’individualité est de plus en plus marquée à mesure qu’on pénètre plus profondément dans les couches les moins cultivées de la société.’

(Gilliéron, 1886:290)

‘Des français régionaux spécifiques [se trouvent] dans un processus de francisation qui aboutira en définitive à la généralisation de la langue zéro.’

(Müller, 1985:137)

This view of RF as ephemeral is, at least in part, born of the fact that it is almost always compared to more standardised forms of the language: ‘des déviations qui apparaissent dans le français “provincial” et qu’on juge telles par référence à une norme très floue: “le bon usage”’ (Lerond, 1973:4). Regional varieties of French are invariably presented in direct opposition to Parisian French which must be considered as ‘le modèle pour un français commun le plus unitaire possible’ (Tuaillon, 1988:291-292).

Social changes, particularly those related to the centralising forces of Paris, are taken to be the reason for this ‘tendance à l’uniformisation de la prononciation³ en France métropolitaine’ (Borrell et Billières, 1989:55). Hornsby notes that

³ Traditional conceptions of RF consider it to comprise phonological, grammatical and lexical variation: ‘les régionalismes du français affectent toutes les parties de la langue: la prononciation, la grammaire, les mots’ (Tuaillon, 1988:292). Contemporary description of RF have tended, however, to focus on phonological and phonetic variation (see, for example, Martinet, 1945; Walter, 1982; Carton et al., 1983).

increasing urbanisation in France over the past century has gone hand in hand with geolinguistic homogenisation, particularly in the north of France, while Armstrong and Pooley view the ‘hypercephalic’ demography of France as promoting the adoption of Parisian speech forms. With reference to pronunciation specifically, they note that RF speakers who do not speak local languages are likely to avoid substrate features in their speech and that regional features which are maintained are likely to be less markedly associated with a traditional regional language (2010:156-158). While sociolinguistic studies of French undertaken over the past two decades have provided concrete evidence to suggest that RF variation in northern France is being reduced in favour more standard varieties of French (cf. Pooley, 1996; Hornsby, 2006; Hall, 2008), the RF of the south of France remains markedly understudied in this respect.

Based on the findings of Wanner (1993) and Kuiper (2005), it is commonly assumed that younger speakers in southern regions of France are systematically adopting a non-local accent, what Hornsby and Pooley refer to as ‘le manque de méridionalité dans la prononciation des jeunes méridionaux’ (2001:510). Armstrong and Pooley (2010) adduce high levels of migration to the south of France as a motivational factor in the adoption by young méridionaux of a northern accent. While the evidence available is suggestive of large-scale homogenisation throughout France, the nature of the RF of young southern speakers has not yet been systematically described and the mechanisms of linguistic change active in their variety of French have not yet been identified.

Finally, we may note that many studies have been concerned with the location of an exact linguistic boundary between RF and the substrate dialects which are assumed

to have influenced its formation. Carton (1981), for example, advanced the idea that there is a linguistic continuum between *patois* (or regional dialect), on one hand, and standard French (SF), on the other: *français général – français régional – français local ou dialectal – patois local*. In this typology, ‘français dialectal’ is viewed as dialect speech which has been heavily influenced by French, a function of the pervasive contact between the varieties. Hornsby notes, however, that there is ‘no clear qualitative or quantitative threshold’ between what Carton terms *français dialectal* and *français régional* (2006:7). Carton’s typology, based on contact between French and a Picard substratum, is only theoretically applicable to contact situations in the *langue d’oïl* area of the north of France. This is because of the typological similarity between French and the other *langue d’oïl* dialects. In the south of France, on the other hand, contact between French and *langue d’oc* substrata is quite clearly an instance of language contact, with clear structural separation between the varieties (Lodge, 1993:74). Boyer (1986) has, however, proposed a similar typology for language contact in the south of France: *français officiel – français colloquial importé – argot français – français d’Oc – francitan – occitan résiduel – occitan reconstitué*. Pooley also notes that ‘distinctiveness’ is an issue when comparing French with all Gallo-Romance varieties (2000:118). I will argue, however, that the typological and structural separation between *langue d’oc* and *langue d’oïl* varieties provides less evidence for a linguistic continuum between French and local *langue d’oc* substrata and that the issue of ‘distinctiveness’ is dramatically reduced.

2. RESEARCH HYPOTHESES

Traditional definitions of RF have led to the over-simplified assumption that, firstly, it consists primarily of residual substrate features and, secondly, that these features are ephemeral and will be lost in favour of more standard features as time advances. This thesis aims to test two general hypotheses which I will henceforth refer to as ‘the residue hypothesis’ and the ‘the ephemeral hypothesis’: RF constitutes dialect residue from moribund substrate varieties; RF is ephemeral and subject to large-scale homogenisation processes. The analysis will identify, through close and systematic linguistic examination, the mechanisms active in the creation of RF during language contact as well as those active during its subsequent development over time, as it comes into contact with other non-local dialects of French.

This thesis offers the RF of Béarn, southwestern France, as a case study. The region of Béarn is primarily rural and the variety of French presented is characteristic of semi-rural areas around the regional capital, Pau. The issues addressed in this thesis, namely the ‘residue’ and ‘ephemeral’ hypotheses, have also been examined by Hornsby (2006) in a situation of bidialectalism in Avion, northern France. Two main contextual factors differ, however, between the studies: Hornsby’s study examines RF formation in a situation of dialect contact between two *langue d’oïl* varieties where this thesis examines RF genesis in a situation of language contact between two typologically dissimilar varieties, one *langue d’oïl* and one *langue d’oc*; Hornsby examines change in RF in a new industrial town while the present study focuses on RF in semi-rural areas at some distance from Paris.

This thesis provides an examination of RF formation in a situation of bilingualism, as opposed to bidialectalism, and aims to shed additional light on the issue of substrate influence, as raised by Hornsby (2006). The analysis focuses on

transfer into French from the local language of the region, often referred to as ‘Béarnais’, and tackles the issue of ‘residue’ from a phonetic and phonological perspective, choosing to exploit acoustic phonetic techniques in order to explain more clearly the nature of substrate interference and interpreting the findings using an analytical framework applied hitherto in studies of second language acquisition, and never with reference to RF. The examination of substrate residue acknowledges, from the outset, the lack of sufficient data on the nature of the variety of French to which bilingual speakers were exposed: it is most likely that southerners first encountered French through contact with other southerners rather than with native speakers from Paris.

In the examination of change taking place in RF as a result of exposure to other non-local varieties of French, I also choose to employ acoustic phonetic techniques: the analysis of fine-grained phonetic data permits this thesis to examine the exact levels of convergence, among younger generations, towards the northern statistical norm. Hornsby’s study identified, in the RF of younger speakers, forms which appeared to be diffusing from Paris but notes that RF varieties at some distance from Paris may be better equipped to resist the loss of local features in favour of non-local forms (2006:137). This thesis challenges the received view that RF is made up of transitional ephemera, focusing on a geographical area some 800 km from Paris (compared to 200 km for Avion), and provides evidence from the south of France that young speakers are not simply adopting northern forms at the expense of local ones. We may note, however, that Hornsby’s ‘young’ informants (aged 0-29 years in 1988) are today aged 26-55 and are not, therefore, directly comparable to the young speakers (aged 16-18) presented in this thesis.

Through an examination of RF formation in a situation of bilingualism and of change over time in RF due to contact with other dialects of French, this thesis offers a unique comparison of the differential outcomes of language contact and dialect contact in RF. Investigating phonetic variation on a continuum permits the analysis presented in this thesis to track change more accurately, and to represent clearly the nature of changes taking place in RF as well as to identify with more certainty the linguistic mechanisms motivating these changes.

3. STRUCTURE OF THE THESIS

This thesis examines how RF arises from *language contact* and how it changes and stabilises over time during *dialect contact*. Two sub-studies address the questions of genesis and evolution respectively by empirically investigating linguistic variation and change in both contact situations.

Chapter One begins with a detailed description of language contact and highlights both the necessary pre-conditions for linguistic transfer as well as the factors that have an influence on the type of transfer that may occur. Flege's (1988, 1990, 1991) Speech Learning Model (SLM) is also presented focusing on L1-to-L2 phonetic and phonological transfer. The linguistic correlates of shift-induced language death are discussed and it is explained that changes occurring in dying languages also occur in 'healthy' languages but that the rate of change is generally much faster. The distinction between language death and dialect death is also highlighted. Chapter One then goes on to discuss the mechanisms of change that are active when dialects of the same language come into contact, namely levelling, diffusion and simplification with reference to Kerswill's (2003) 'Regional Dialect Levelling' and Trudgill's (1986) 'Koinéization' models of language change. Chapter

One ends with a case study, describing Hornsby's application of the koinéization model to a situation of dialect contact in northern France.

Chapter Two presents the varieties that are involved in language contact, French and Béarnais, as well as the variety that has emerged from this language contact, RF. The chapter begins with an external history of the imposition of French in Béarn, a detailed overview of the remaining Béarnais speech community in the twentieth century and touches on linguistic and ideological definitions of Béarnais as a language or a dialect. The chapter then provides a detailed phonological description of Béarnais, comparing it along the way to standardised 'Occitan', or *langue d'oc*, norms and to the phonology of SF and the northern French norm, with the aim of identifying features that have the potential to transfer during language contact or, conversely, to be adopted during dialect contact. Traditional accounts of RF phonology are then presented for the southwestern region and for the south of France more generally, drawing on a selection of available impressionistic data. The language contact study is then presented including the variables to be examined and the predictions of the SLM in each case. The final section outlines the variables selected for the dialect contact study and discusses the outcomes predicted by the models of language variation and change presented in Chapter One.

Chapter Three outlines the methodology employed in the empirical analysis of linguistic variation and change in RF: sample design, including fieldwork sites and informant selection procedures; data elicitation techniques used in both studies to build corpora for Béarnais and French; transcription and segmentation protocols; acoustic phonetic analysis; normalisation procedures; auditory analysis; coding schemas (including dependent and independent variables); statistical modelling techniques. The language contact and dialect contact studies are both 'sociophonetic'

in nature, involving an acoustic phonetic analysis with rigorous adherence both to analytic ‘best practices’ and to a Labovian sociolinguistic research methodology.

Chapter Four presents the results of the language contact study and addresses the question of how the phonology of RF arises, focusing on phonological and phonetic transfer from Béarnais into French. It begins with a systematic analysis of the Béarnais and French mid-vowel and nasal-vowel systems focusing on data from the oldest (65+) generation of bilingual speakers. The presentation is grouped by language: the mid- and nasal vowel systems of Béarnais (the speakers’ L1) are examined before those of French (the speakers’ L2). The analysis of French parallels, as far as possible, that of Béarnais in order to facilitate comparison. The final section of Chapter Four provides evidence for phonetic and phonological transfer from Béarnais into French in the speech of the older bilingual speakers and examines the applicability of Flege’s Speech Learning Model to the interference observed. This analysis identifies the linguistic mechanisms, active during the formation of RF, which promote and inhibit ‘substrate residue’, in the form of phonetic and phonological transfer.

Chapter Five presents the results of the dialect contact study, using the findings of the language contact study as a reference point: the French of the older bilingual speakers is compared to two younger generations of monolingual French speakers in order to examine language change in apparent time. The outcomes of contact between emergent RF and other contiguous and incoming varieties of French are assessed, focusing particularly on evidence for convergence towards the northern French norm in the speech of younger generations. Variation in both the mid- and nasal vowel systems is analysed separately, from a synchronic perspective, for each of the three generations, comprising an acoustic and statistical analysis in each case.

Change in apparent time is subsequently investigated, from a diachronic perspective, for the mid- and nasal vowel systems. Evidence for phonetic and phonological change identified in the RF is interpreted using the theories of dialect levelling outlined in Chapter One in order to explain why some localised features of RF are lost while others have been retained.

CHAPTER 1

LANGUAGE CONTACT AND DIALECT CONTACT

« Dès l'instant qu'ils furent disséminés, les hommes adoptèrent donc de nouvelles conduites de vie qui donnèrent lieu, par la même occasion, à l'apparition de formes nouvelles dans leur langue de communication. [...] troisième cause de la mutation des langues. C'est l'émigration et le mélange des peuples qui entraînent le mélange de celles-ci. De là la naissance de nouvelles langues. »

(Jan Amos Comenius, *Novissima Linguarum Methodus*, 1648).

This chapter examines the related phenomena of language contact, language death and language change. Focusing on bilingualism, the first section discusses the factors which may influence the type and amount of linguistic transfer or interference that can occur when two languages come into contact with each other. Special emphasis is placed on those linguistic changes that occur via transfer in shift-induced contact where one language is ousted from its historical territory by an incoming dominant language. The theoretical underpinnings of Flege's Speech Learning Model (SLM) are presented in detail, examining in particular unilateral L1-to-L2 transfer at the phonological and phonetic linguistic levels. The second section focuses on language obsolescence and on the structural consequences of language shift in the variety that is being displaced. The difference between language death and dialect death is also discussed, focusing both on varying terminological usage and on the types of change that may occur in both situations. The final section discusses linguistic changes which may take place in varieties of the dominant language that have emerged from

language contact after the ‘dust’ of contact has settled. This discussion will focus primarily on the reduction or attrition of marked localised features in the emergent variety when it comes into contact with other dialects of the same language.

1.1 LANGUAGE CONTACT

Weinreich notes that transfer, which he calls ‘interference’, results in ‘the rearrangement of patterns, arising from the introduction of foreign elements into the more highly structured domains of language, such as the bulk of the phonemic system, a large part of the morphology and syntax, and some areas of the vocabulary’ (1968:1). The influence exerted by one language on another may vary largely depending on the linguistic level in question which is, in turn, dependent on the nature of the contact situation, particularly on whether bilingualism exists, the degree of bilingualism and its duration (Hickey, 2010:7). Bilinguals are largely seen to be the locus of change because competence in two languages is a precondition for the adoption of material from one language into another, independently of their degree of awareness of the separateness of their linguistic (sub)systems (Hickey, 2010:9). While some traditional views see the dominant language as influencing the less dominant language, Hickey criticises this view as being overly simplistic because transfer between languages in contact is normally bilateral. Particularly for contact that persists over many generations, the substrate can have ‘a gradual and imperceptible influence on the superstrate leading in some cases to change at a later time [...] This type of contact can be termed ‘delayed effect contact’ (Hickey, 2010:8). The argument that transfer occurs through bilingual speech in a contact situation is not widely contested but the type and amount of interference observed can depend largely on contextual factors.

1.1.1 THE MOTIVATIONS FOR LINGUISTIC TRANSFER

It is now generally accepted that it is necessary to take account of both internal and external motivations for language change as well as how these motivations interact. Thomason (2010) offers a set of conditions that must be satisfied before we may establish that a given change is externally motivated:

- (i) the receiving language (B) must be considered as a whole, not a single piece at a time because the chances that just one structural feature travelled from one language to another are vanishingly small:
- (ii) a source language (A) must be identified that is, or was, in sufficiently intimate contact with B to permit the transfer of structural features:
- (iii) features shared by A and B must then be examined (though they need not be identical in both languages because transferred features often do not match in the source and receiving languages):
- (iv) the researcher must demonstrate that (source) features are old in A, that is, they must show that the features are not innovations in A:
- (v) the researcher must then demonstrate that (transferred) features are innovations in B, that is, that they did not exist in B before it came into contact with A.

(after Thomason, 2010:34)

Even after all of the above conditions have been satisfied, and an external cause of language change has been advanced and/or solidly established, the influence of internal factors must also be considered because deciding between external and internal causes is often fruitless, with the best historical approaches integrating both types of motivation (Thomason, 2010:34). If all five of the above prerequisites can be met, the case for contact-induced change is nevertheless said to be sound, but if

one or more cannot be met, then any claim of external causation is tentative at best.

Having advanced these contact diagnostics, Thomason then discusses what she terms ‘predictors’ in contact scenarios, which describe the conditions under which types of change may take place. A distinction is drawn between contact situations in which one group of speakers shifts to another language and fails to learn it fully and other situations where speakers are fully bilingual and imperfect learning plays no role. The predicted outcomes for each situation are very different with shift-induced transfer occurring primarily at the phonological and syntactic levels with little or no lexical item transfer from the shifting group’s original language into their target language. If the people involved in contact are fluent speakers of both languages, the first and predominant transferred features are lexical items. Later, after the languages have been in contact for some time, structural features may also be transferred (Thomason, 2010:36). Irish English is an example of shift-induced phonological transfer where Irish speakers shifting to English transferred certain features of their original language onto their pronunciation of English. Mufwene describes the modified version of the language that ‘won’ in the language shift scenario as having experienced a ‘pyrrhic victory’ (2001:162), since it emerges from contact in a modified form that has not reached the target of the original contact variety. We thus have a dichotomy between fully bilingual communities where imperfect learning plays no role, leading primarily to lexical interference while structural feature transfer lags behind, and a monolingual community shifting from one language to another, with imperfect learning through unguided second-language acquisition, leading primarily to phonological and syntactic transfer, while lexical item transfer lags behind.

Where there are high levels of stable bilingualism, intensity of contact is typically related to the duration of contact and the level of bilingualism in the speech community (Thomason, 2010:36). These two factors are related in that greater levels of bilingualism will result from longer contact periods. In situations of shift, levels of intensity vary according to factors such as the relative sizes of the populations speaking the source and receiving languages, the degree of access to the target language by the shifting group and the length of time over which the shift occurs (Thomason, 2010:37). If the language shift occurs abruptly, a relatively large amount of phonological and syntactic transfer is likely. Where the shift occurs very slowly, little or no shift-induced transfer can be expected. However, shift-induced transfer may be found in long-term contact situations in which imperfect learning was dominant early on, followed by a high level of bilingualism over a considerable period of time and finally by the completion of the language shift to the incoming language. Having been fixed at a time when the level of bilingualism was low, the language of the shifting group never converged towards the target language as it was spoken by the original speech community. Thomason provides the example of the French spoken in the originally Breton-speaking community of *Île de Groix*, where by 1970 only the oldest community members were fluent in Breton but the French spoken there was heavily influenced by Breton in both structure and vocabulary.

In contact-induced change, the degree of typological difference between specific subsystems of a source language and a receiving language also helps to predict the kinds of transfer that may occur. Morphology tends to lag behind phonology and syntax in terms of those features that are transferred from one language into another, in both shift-induced transfer and transfer in which imperfect learning plays no role. In cases where languages in contact differ significantly in

inflectional and other categories, typological distance is said to prove a barrier to contact-induced change, though not an absolute barrier: when the languages involved in contact are very different typologically but contact is very intense, any linguistic feature can be transferred, but transfer occurs primarily at the phonological and syntactic levels (Thomason, 2010:41). Where typological distance is small, linguistic subsystems for which contact-induced change is rare, such as inflectional and derivational morphology, may be affected by transfer (Thomason, 2010:40). In short, higher levels of typological similarity will allow more contact-induced transfer to occur and on more linguistic levels; greater typological distance, conversely, will reduce the amount of transfer that can occur.

1.1.2 PHONEMIC COGNATES AND PHONETIC TRANSFER

This section focuses on unilateral L1-to-L2 transfer examining both phonological and phonetic interference. The linguistic mechanisms by which structural units may transfer are presented and it is argued that structural correspondences at an abstract phonemic level constitute a prerequisite for linguistic transfer, based on the argument that bilinguals are unable to avoid long-term transfer from one language to another because of their identification of similar phonological categories in their two languages (Watson, 2002:245).

1.1.2.1 PRIMARY AND SECONDARY SYSTEMS

In order to conceptualise the abstract level at which the phonological categories of two languages are equated, Weinreich makes a distinction between the bilingual's 'primary' language and their 'secondary' language (1968:14). He uses these terms, rather than 'mother tongue' and its opposite, to highlight the fact that we cannot

always assume the primary language to be the native one. For Weinreich, determining which of the two systems was learned first is irrelevant: all that matters is to identify which language is the source language and which language is the recipient language where 'source' and 'recipient' are directly equated with 'primary' and 'secondary' (1968:74). Weinreich states that transfer will arise when a bilingual identifies a phoneme of the secondary system with one of the primary system and, in reproducing it, subjects it to the phonetic rules of the primary language (1968:14). Thus, a contrastive analysis of the phonemes of two languages and the rules by which they are realised can yield a list of forms which we might expect to transfer in a given contact situation. Of course, both languages in contact can act as the source and recipient for different instances of transfer since there are two ways in which contact can be experienced by bilinguals: one system with reference to another, and the other way round (Weinreich, 1968:14).

1.1.2.2 THE SPEECH LEARNING MODEL

The Speech Learning Model (SLM), advanced by Flege (1988, 1990, 1991) combines, in a single explanatory framework, the linguistic mechanisms by which sounds or units of sound may transfer from one language to another during bilingualism. The SLM postulates that the sound system of a speaker's L1 is structurally divided into three levels (1991:407): phonemic categories (contrastive sounds), which are linked to phonetic categories (where information on features of the sound are stored) and 'phonetic realisation rules' which provide articulatory information and govern allophonic alternations. During the acquisition of an L2, the process of 'interlingual identification' causes words learnt in the second language to be (initially) decomposed into categories based on familiar L1 sounds (Flege,

1995a:98). This (initial) association of L2 sounds with L1 categories is the basis for the central tenet of the SLM: the categories making up the L1 and L2 subsystems of a bilingual exist in a ‘common phonological space’ and so have the potential to mutually influence one another (Flege, 2007:366). This relates to the idea that bilingual speakers can never function in either the L1 or L2 in exactly the same way as monolingual speakers would: one phonetic subsystem cannot be fully deactivated while the other one is in use.

Phonemes in the L1 and L2 that correspond structurally are termed ‘cognate phonemes’ and are said to be linked by ‘equivalence classification’. An L2 sound is said to have been ‘equated’ with an L1 sound if it continues to be processed as an instance of an L1 category (Flege, 2007:367). When L1 and L2 sounds have been equated as members of the same phonetic category, the SLM predicts that they will eventually resemble each other in production. Equivalence classification does not, however, prevent L2 learners from auditorily detecting phonetic differences between an equated L2 sound and its L1 counterpart. Establishing evidence for category formation is important in the SLM as production accuracy has been shown to depend importantly on whether new categories are created for L2 sounds not occurring in the L1 (Flege, 1997:86). Category formation is directly linked to equivalence classification within the SLM: if an L2 sound is equated with an L1 sound, new category formation will be inhibited; if an L2 sound is not equated with an L1 sound, a new phonetic category may be formed. The formation of a new L2 category is determined by a number of factors, such as the perceived phonetic distance⁴ of L2 sounds from the closest L1 sound as well as the state of development of the learner’s

⁴ Versions of the original SLM (1984-1993) posited a tripartite ‘identical-similar-new’ division to classify sounds of the L2 (relative to those of the L1). Flege (2005) notes that, from 1994 onwards, phonetic distance has been considered as a continuum by the SLM which must be measured empirically (acoustically).

L1 phonetic system at the time that L2 learning commences (Flege, 1997:86). Equivalence classification and category formation (which are mutually exclusive in the SLM) predict the interaction of L1 and L2 phonetic subsystems to be governed by the two different linguistic mechanisms of ‘phonetic category assimilation’ and ‘phonetic category dissimilation’, respectively.

The SLM proposes that the L1 and L2 phonetic subsystems will interact through the mechanism of phonetic category assimilation when category formation has been blocked by equivalence classification. When a category is not formed for an L2 sound because it is ‘too similar’ to an L1 counterpart, the L1 and L2 sounds will assimilate, leading to a ‘merged’ L1-L2 category (Flege, 2005). Within the merged category, the L2 sound will continue to resemble the L1 sound, and the L1 sound will begin to resemble the L2 sound (bilateral interference):

‘production of an L2 sound will be modified slowly over time if the L2 sound differs audibly from the L1 sound with which it has been equated. The modification will be limited, however, because a single long-term memory representation will be used to process instances of the L2 sound and its L1 counterpart. This long-term memory representation ‘phonetic category’ will gradually evolve over time, yielding a ‘merged’ category that reflects both L1 and L2 phonetic input.’

(Flege, 2007:368)

Importantly, Flege notes that depending on the nature of the input received by the merged phonetic category (more L1 or more L2), the category may resemble more closely the long-term representation of L1 and L2 monolinguals. The exact nature of these representations will reflect the large levels of input acquired over a speaker’s lifetime, with more recently encountered input being weighted more heavily than input encountered in the distant past (Sancier and Fowler, 1997). An important consequence of phonetic category assimilation is that production of both L1 and L2 sounds will eventually manifest the specification stored in the merged phonetic category. This means that while L1 and L2 sounds might originally be phonetically

distinct from each other, their storage in a merged category will eventually lead them to resemble each other in production and to be realised phonetically as the same sound. These processes of cross-language phonetic assimilation can lead to situations where monolingual L1 and L2 speakers evaluate bilingual speakers as sounding ‘foreign’ in each of their languages.

Phonetic category dissimilation occurs when a newly established L2 phonetic category is relatively close in phonetic space to a pre-existing L1 category (Flege, 2007:375). This process of dispersion works to optimise the maintenance of phonetic contrast in the vowel space for separate phonetic categories, in much the same way that vowels in a single language disperse in the vowel space (Flege, 2007:370). Dissimilation of L2 and/or L1 phonetic categories after new category formation also leads to a situation where a bilingual’s pronunciations diverge from those of monolinguals in each of the languages because the bilingual’s representation is based on different phonetic features or feature specifications than a monolingual’s.

Phonetic realisation rules are said to be used to ‘motorically’ output the sound represented in a given phonetic category. The SLM acknowledges the possibility that L1 and L2 sounds that have been equated as ‘the same’ may not occur in the same range of phonological or phonetic contexts in both languages: phonotactic constraints and allophonic variation may differ cross-linguistically. While L1 and L2 sounds may be equated in the same phonetic category, and their total range in production may be shown to overlap phonetically, the distribution of contextual variants may vary (Flege, 1995a:98). Flege notes that the level of analysis at which the phonic elements of a bilingual’s two languages are perceptually related remains uncertain and that the influence of contextual variants on cross-language perceptual assimilation is also unclear (2007:377).

1.1.2.3 MODIFYING THE SLM: EARLY AND LATE LEARNERS

The SLM makes an explicit distinction between early learners and late learners. Flege proposes that while both early and late L2 learners equate the corresponding phonemes in each of their languages, late learners differ substantially from early learners in that they are more likely to realise L2 sounds as instances of L1 phonetic categories: category formation for an L2 sound is said to become less likely through childhood as representations for neighbouring L1 sounds develop. One interpretation of this is provided by Baker et al. (2002), who view robust, developed L1 categories as ‘more powerful attractors’ for L2 speech sounds, which are thus more likely to be subsumed by the L1 category. We may also note that as the age of L2 learning increases, L2 learners will be less likely to note distinctions between L2 sounds that are based on a property which is not used to distinguish sounds in the L1. While early learners are more likely to establish new L2 categories, late learners do, however, retain some capacity to form new categories, contrary to traditional critical period hypotheses.

Watson discusses Flege’s view that early learner bilinguals or those who have been bilingual from birth should, having the opportunity to develop their phonological systems in tandem, be able to establish and maintain an optimal degree of separation between them (2002:245). He views the notion of ‘optimal degree of separation’ as problematic because it seems plausible that, if both early and late learners equate the phonemes of both their languages at the phonemic category level, then it is equally likely that early learner bilinguals will initially have had to work with a single set of phonetic categories too, even if they have since separated the specifications for equivalent phonemes at the phonetic category level (2002:248). Watson argues against the division of bilinguals into late and early learners because

this division is explanatorily inadequate: while early learner bilinguals may achieve functional separation between two equivalent phonemes in their languages at a phonetic category level, the cross-linguistic association of these phonemes provides a mechanism whereby transfer may occur. Watson states that each phonetic category is established by experience and continues to be modified in light of further experience:

‘primary bilinguals will, quite early, develop different categories for cognate sounds in their two languages, and will go on modifying them. Late bilinguals will start learning their L2 with a pre-existing category from their L1, which they will only slowly come to modify.’

(Watson, 2002:259)

Watson sees the integration of the notion of ‘experience’ into the SLM model as allowing the model to account for differences between early and late learners without appealing to different types of representation. The modified model specifies that both early and late bilinguals learn their L2 in a similar way, both establishing distinct phonetic categories (over time) for both of their languages, but in the case of the late learners, ‘the number of exemplars of monolingual-like production stored in memory is insufficient to change the overall prototype sufficiently from its original L1 setting’ (2002:259). Indeed, the focus of more recent studies by Flege and others (e.g. Flege, 2007) has been on the difficulty in adducing ‘age of learning’ as an explanatory factor in instances of transfer because it is frequently confounded with other factors that may influence performance (input, language use, bilingual dominance). Finally, we may note that even when the phonetic category for the L2 is sufficiently developed and, in theory, each incoming exemplar (in either language) should be assigned to the relevant language-specific phonetic category, Watson argues that, although the process is efficient, it may malfunction resulting in ‘leakage’ from one category to another (2002:260).

The large majority of research undertaken using the SLM has focused predominantly on second language learners in the traditional sense, speakers who have learnt a language that is not normally spoken in their nation, and who are, in essence, speaking their L2 with a ‘foreign accent’. The central emphasis of a large number of these studies, undertaken primarily by Flege in conjunction with a variety of other researchers, was on the effect of ‘age of learning’ on the perception and production of ‘non-nativelike’ sounds by L2 speakers of a variety of languages. We might hypothesise that the theoretical linguistic principles governing ‘transfer’ in situations of foreign language learning would be the same in situations of long-term language contact, though different social and language external factors are likely to modify the outcomes of the SLM in each case.

1.2 LANGUAGE DEATH AND DIALECT DEATH

When examining a case of shift-induced L1-to-L2 transfer, it is also important to take account of the linguistic correlates of obsolescence in the variety that is being replaced. It is thus necessary to have a detailed and accurate description of the changes which have taken place in the source language in addition to an account of its historical representation. From a typological perspective, we have seen that the level of structural similarity between languages in contact determines the nature and amount of linguistic transfer that may occur. Linked to typological similarity are the separate but related processes of language death and dialect death.

Language obsolescence may be defined as a process whereby a language is ousted from its territory by another language leading to a decline in its number of speakers and ‘during which gradual reduction in use, due to domain-restriction, may result in the emergence of historically inappropriate morphological and/or

phonological forms together with extensive lexical borrowing' (Jones, 1998:5). Language death may be seen as the end point of this obsolescence process which occurs at a superordinate level between distinct language varieties: structural separation and typological dissimilarity between the dominant and obsolescent language are largely maintained. It is important to note that language obsolescence is a combination of socio-political and linguistic changes and, indeed, the former gives rise to the latter.

Dying languages generally undergo the same types of linguistic change as 'healthy' languages. The types of changes that we observe in the structure of a dying language are not notably different from those well established in the study of language change in general, 'but the time span for change seems compressed and the amount of change seems relatively large' (Dorian, 1981:154). Thus, in 'healthy' languages, a few changes will occur almost imperceptibly over a considerable period of time, but during language obsolescence, it is possible to witness many different types of change over a matter of generations (Dorian, 1981:151). Structural changes that occur in obsolescent languages may or may not be directly attributable to the influence of an encroaching language. Many changes observed in formal language structure cannot necessarily be explained by external factors (Jones, 1998:249): simplification leading to increases in regularity; the complete loss of structural elements, e.g. the loss of case distinctions in East Sutherland Gaelic (Dorian, 1981:130); increases in transparency or the use of more analytic than synthetic structures; the generalisation of unmarked categories, e.g. loss of soft mutations in Welsh. Other changes may be a result of externally motivated transfer from the dominant language (Jones, 1998:252-257): grammatical interference, e.g. syntactic calques; phonological interference; code-switching; lexical borrowing.

Dorian takes the view that the linguistic benchmark for the ‘norm’ in a dying language should not constitute the standard historical representations of the language but rather the internal conservative norm represented by the oldest local speakers (1981:80). As the language shift advances, the historical norm serves as little more than a theoretical construct representing some ‘pure’ past version of the obsolescent language. Therefore, we must examine its contemporary structure in order to establish that the features we may expect to be involved in transfer are still present.

Dialect death, also known as ‘dedialectalisation’, is the process by which a specific localised variety of a language becomes obsolescent and dies out. It thus occurs on a subordinate level and does not involve a ‘whole’ language. For the purpose of this discussion, I follow Dorian in defining a dialect linguistically, as a particular local variety of a larger superordinate language (1981:8). Dialect death has been defined in a variety of different ways, three of which will be discussed below, although these definitions are by no means exhaustive.

Dorian described East Sutherland Gaelic as a particular local dialect of the Scottish Gaelic language that is yielding to an equally particular local dialect of the English language, East Sutherland English (1981:8). Scottish Gaelic will not become extinct with the loss of East Sutherland Gaelic and by this definition, only a particular local variety, and not a language will have died. Dorian herself points out that this definition of dialect death is problematic: the whole Scottish Gaelic language is threatened by (Scottish) English at a superordinate level. Therefore, the competition, at a national (Scottish) level, is between two typologically distinct languages, Gaelic and English; at a local level, the question is always which language, and not which dialect, to speak. Since, in the local context, the death of East Sutherland Gaelic will mean that a language, and not a dialect, will have died,

this situation may more accurately be described as one of language death. By this definition, ‘dialect death’ is just one localised step in the language shift process: the gradual elimination of all dialects of Gaelic by English.

A second type of dialect death sees a particular local variety of a language being replaced by a supralocal or national variety of the same language. In this case, dedialectalisation, at a subordinate level, leads to the replacement of local features with other non-local features of the same language. For example, Jones notes that since the introduction of Welsh-medium education in Wales, ‘there is now occurring a phenomenon whereby local Welsh is being replaced by a Welsh that includes non-local features, most of them features of Standard Welsh but some also associated with other regional dialects’ (1998:260). It is also worth noting that, in the case of Welsh, as with Scottish Gaelic, these local varieties are also threatened by English at a superordinate level.

A third definition of dialect death falls somewhere between those of Dorian and Jones. This type of dialect death, which comprises both language shift and dedialectalisation, has been discussed by Hornsby (2006) in relation to Picard and French which evolved, largely independently, from Latin and are historically bound to the regions of Ile-de-France⁵ and Picardy respectively. They are both classified as *dialectes d’oil* and they exhibit many structural similarities common to varieties of northern Gallo-Romance. Following the imposition of French as the national language, language contact led to high levels of linguistic convergence towards French in Picard because of the typological similarity between the languages. This convergence has been so great that ‘it has fostered the perception that Picard is no more than a debased subvariety of French’ (Hornsby, 2006:9). On this observation,

⁵ The emergence of French or ‘francien’ also involved high degrees contact and mixing with other northern Gallo-Romance varieties. It is thus not as straightforwardly localised as Picard (cf. Lodge, 1993).

Hornsby treats Picard obsolescence as a case of dialect death rather than language death. This ‘dialect’ has subsequently been ousted from its territory by French by the process of dedialectalisation, in the same way that regional varieties of Welsh are yielding to non-local Welsh forms. This definition of dialect death is, however, dependent on delineating some form of boundary at which one language becomes another.

1.3 DIALECT CONTACT

This section is concerned with linguistic changes which may occur in emergent or post-contact varieties of the dominant language, focusing particularly on externally motivated changes occurring as a result of contact with other varieties of the same language. Two dialect contact scenarios may be identified: contact with contiguous varieties; contact with incoming varieties due to in-migration. Both scenarios result in focusing of the post-contact variety whereby linguistic mechanisms promote structural stability as well as the reduction or attrition of localised features. The discussion which follows aims to identify these linguistic mechanisms and to describe their role in language variation and change, focusing primarily on phonetic and phonological evidence.

1.3.1 CONTACT WITH CONTIGUOUS AND INCOMING DIALECTS

When speakers of a local variety come into contact with speakers of other regional or non-local varieties, we often find that, over time, the differences between the varieties will be reduced. Kerswill calls this phenomenon ‘regional dialect levelling’ (RDL) which is claimed to be ‘leading to the loss of localised features in urban and

rural varieties of English in Britain, to be replaced with features found over a wider region' (2003:223). The phenomenon of RDL arises from the interplay of at least two focusing⁶ mechanisms: levelling 'proper' and geographical diffusion. Before describing each of these processes in detail, it will first be necessary to briefly define 'speech accommodation' which theoretically underpins both levelling 'proper' and geographical diffusion. Speech accommodation is a social-psychological language change mechanism whereby, in a dyadic situation, speakers converge to, or diverge from, the variety spoken by their interlocutor in order to gain social favour or distinguish themselves socially (Trudgill, 1986:2). Trudgill argues that long-term linguistic changes occurring in dialect contact situations result from multiple such short-term, face-to-face interactions between individual speakers. The linguistic forms which are accommodated to are not necessarily phonetically identical to the original form. Trudgill calls this accommodation 'imperfection', explaining that speakers in dyadic situations aim to reduce dissimilarity between their speech and that of their interlocutors while at the same time not imitating them slavishly (1986:57). We may note that the occurrence of accommodation is dependent on the social network characteristics and the social mobility of the speakers involved with close-knit communities impeding change and loose social network ties favouring higher levels of interaction, more accommodation and thus, more linguistic change.

1.3.1.1 LEVELLING 'PROPER'

Levelling 'proper' is defined as a process promoting the 'reduction or attrition of marked variants' (Trudgill, 1986:98), where marked refers to forms that are unusual or in the minority. In the regional context, this means that localised varieties in

⁶ 'Focusing' denotes linguistic change in the direction of a relatively uniform, homogeneous, and socially unifying language norm (cf. Le Page, 1980).

contact with each other become more like one another and reduce the differences between them. Levelling ‘proper’ is facilitated by speech accommodation and often leads to the creation of a new variety, over a wider geographical space that is characterised by the absence of highly-localised forms. At the structural level, the outcome of levelling is a ‘reduction in exponents of phonological and morphological categories’ between varieties in contact (Kerswill et al., 2005:1024). The linguistic outcomes of levelling ‘proper’ lead, over time, to the adoption of pan-regional forms: the use of new, regionally specific but geographically widespread features that retain majority regional features at the expense of localised ones. Features that are common to a number of contiguous varieties are more likely to survive the levelling process than those variants that have a specifically localised affiliation. For example, Watt (2002) describes how the traditional Newcastle variant [ɪə] of the FACE diphthong is being replaced by younger speakers with the monophthongal realisation [e:] which has wider geographical currency, in that it is a more widespread northern British English variant (see Section 1.3.1.3). This change, combined with others such as [o:] for the GOAT diphthong, is symptomatic of pan-regionalisation: Newcastle English is becoming more like other northern varieties via levelling ‘proper’.

1.3.1.2 GEOGRAPHICAL DIFFUSION

Geographical diffusion is defined as the process by which linguistic features spread out from a populous and economically and culturally dominant centre (Kerswill, 2003:223), which is often, but does not have to be, the capital city. At an individual level, geographical diffusion, is also motivated by speech accommodation as features spread via face-to-face interactions with other speakers, from elsewhere, who have

already adopted the feature in question. The spread of diffusing linguistic features is wave-like, in that they radiate outwards from a central focus reaching geographically nearby locations before those at greater distances. This wave-like diffusion is often modified by the likelihood that nearby towns and cities will adopt the diffusing features before more rural areas in between (Kerswill, 2003:223). This is termed ‘urban hierarchical diffusion’ which is explained by Trudgill’s ‘gravity model’ (1986): linguistic innovations are said to be leaping or ‘parachuting’ according to a defined hierarchical pattern, beginning in the largest urban centre and spreading to rural areas via smaller and smaller ‘satellite’ towns (Trudgill, 1986:39). Hierarchical diffusion therefore involves a demographic factor – the population size of the communities involved in the interaction – and a geographical factor – the distance between urban centres. For example, Kerswill (2003) presents evidence that TH-fronting, that is, the use of non-standard [f] for /θ/ word-initially, word-medially and word-finally and non-standard [v] for /ð/ word-medially and word-finally, is diffusing hierarchically from London (see Section 1.3.1.3). This change was adopted in geographically close urban centres first, for example, in Norwich before Newcastle, and in larger urban areas before rural areas in between, for example, in Derby (population, 236,000) before Wisbech (population, 19,000), although the latter is geographically nearer to London.

1.3.1.3 REGIONAL DIALECT LEVELLING

RDL ‘is an outcome of various partly geographical-based language change processes. One of these is geographical diffusion, another is, of course, levelling, in the sense of mutual convergence’ (Kerswill, 2003:223). To avoid terminological ambiguity, ‘levelling, in the sense of mutual convergence’ will henceforth be

referred to as levelling ‘proper’. Kerswill states that RDL may also be referred to as ‘supralocalisation’. At this point, we may distinguish pan-regionalisation, which is promoted by levelling ‘proper’, and supralocalisation, which involves both levelling ‘proper’ and the adoption of non-local features via diffusion. The following examples demonstrate the process of supralocalisation in Newcastle English which is becoming more like other northern varieties with which it is in contact (via levelling ‘proper’) and, at the same time, more like all other varieties of British English (via geographical diffusion).

As mentioned previously, the traditional realisation of the FACE diphthong in Newcastle, [iə], has been subject to monophthongisation, [e:], by younger speakers. Watt (2002) showed that men aged 15-27 use the ‘new’ variant 64% of the time while older men, aged 45-67, use it only 37% of the time. Women of both age groups, young and old, use the ‘new’ variant 95% and 92% of the time, respectively. It is clear from these results that the old [iə] variant is becoming obsolescent, particularly in female speech. Kerswill sees this change as largely resulting from levelling ‘proper’ within the north-eastern region leading to the adoption of a majority northern variant (pan-regionalisation) and does not deem there to be any striking evidence to suggest that this feature is diffusing from elsewhere.

Kerswill does, however, provide evidence for the adoption of TH-fronting via geographical diffusion in Newcastle English (2003:230). The use of [f] for /θ/ and of [v] for /ð/ is shown to have diffused from south to north, originating in London. There is also evidence to suggest that these changes were adopted simultaneously by larger urban centres, such as the Tyneside conurbation and the Scottish central belt. Kerswill compared TH-fronting in Newcastle and Durham and shows that, in both

localities, young male speakers use the fronted variants more frequently than young female speakers and that young males use more fronting of /ð/ than of /θ/, while females show no such difference (2003:12). This feature appeared to enter urban Newcastle and semi-rural Durham at the same time via geographical diffusion and it was therefore not possible that the feature had spread from Newcastle to Durham. This demonstrates that a diffusing feature may be adopted at the same time by demographically divergent localities within the same region.

Kerswill and Williams' (2000) study comparing realisations of the MOUTH vowel in both Reading and Milton Keynes shows that, for a given change, both levelling and diffusion may work together. The findings of this study demonstrated that two MOUTH variants, [ɛʊ] and [ɛɪ], present in the speech of older speakers have completely given way to [aʊ] over two or three generations. Reading is somewhat behind Milton Keynes regarding this change but Kerswill and Williams argue that this is due to relatively more close-knit social networks in Reading. We must also note that the new town, Milton Keynes, constitutes a specific dialect contact situation which is characterised by large-scale in-migration to a compact geographical area (see Section 1.3.2). In both towns, however, the change towards [aʊ] is in the direction of the more geographically neutral and RP-like variant. In fact, this change is taking place simultaneously throughout the southeast of England, indicating dialect pan-regionalisation via levelling 'proper'. This change may also, however, be diffusing from London because some commuters travel up to two hours in each direction on a daily basis and the geographical proximity and relative population sizes of the areas involved (eight million for London; 180,000 for both Reading and

Milton Keynes) are favourable to the adoption of linguistic features via geographical diffusion (Kerswill, 2003:229).

Distinguishing between the processes of levelling and geographical diffusion in particular cases requires us to consider two types of information. Firstly, we must look for dialect-geographical evidence for the spread of a feature to see whether the apparently ‘new’ feature is diffusing gradually across geographical space or whether it is establishing itself simultaneously throughout a given area, in which case it would appear that levelling is present (Kerswill, 2003:224). Kerswill also notes that the levelling mechanism is unlikely to apply over a large and demographically complex area such as Great Britain. Thus, if change is spread over expansive geographical space, we must suppose – other things being equal – that geographical diffusion is the more likely mechanism (2003:236).

1.3.2 NEW DIALECT FORMATION: KOINÉIZATION

Trudgill stresses the importance of distinguishing between two different types of dialect levelling. The first sense is equivalent to German *dialektausgleich*, whereby dialect areas enlarge, and dialect diversity is lost to a certain extent (see Section 1.3.1). The second sense is parallel to German *nivellierung* whereby, in situations of dialect mixing, dialect levelling is characterised by a reduction in the number of forms available in the contact mix (in Watt, 2002:59; cf. Trudgill, 1999). Levelling in the second sense is commonly described as ‘koinéization’: ‘the linguistic process that occurs when different dialects or closely related subsystems come into contact’ (Siegel, 1993:6). During koinéization, the focusing mechanisms of levelling ‘proper’ and simplification lead to the formation of a new dialect. Three pre-conditions must be present in order for new dialect formation of this type to occur: large-scale in-

migration to a relatively compact geographical area; native speakers of different mutually intelligible dialects of the same language; face-to-face interaction between speakers of the different incoming dialects. Thus, like RDL, koinéization is also motivated by speech accommodation but dialect contact is said to have been ‘heightened’ by the presence of in-migration (Kerswill and Williams, 2000:70). It is also heavily influenced by the demography and social network characteristics of the in-migrating populations.

Within the koinéization model, the outcomes of levelling ‘proper’ are, in principle, the same as those described for RDL above (Section 1.3.1.1) but the sources of variation are different: during pan-regionalisation, levelling ‘proper’ promotes the adoption or retention of majority regional forms at the expense of localised ones; during koinéization, on the other hand, levelling ‘proper’ promotes the retention of majority forms in the dialect mix at the expense of minority forms. Additionally, levelling ‘proper’ generally occurs within a relatively compact geographical space during koinéization and thus lacks the geographically-based distribution inherent in the creation of pan-regional varieties (Kerswill, 2003:236). Kerswill and Williams (2000) have shown that the establishment of a new town, such as Milton Keynes, provides the perfect conditions in which to examine the outcomes of koinéization. In Milton Keynes, the large majority of in-migrants came from the southeast of England (76%). The migrants’ children were shown to adopt non-standard majority southeastern ‘input’ variants such as [f] for /θ/, [v] for intervocalic /ð/, [ʔ] for intervocalic and final /t/, variable h-dropping and labiodental [v] for /r/. The adoption of these majority forms is at the expense of other minority forms in the dialect mix such as [t] for intervocalic /t/, for example.

We may note here that children are central to linguistic focusing during koinéization as they, over time, filter out the variation from their parents' collective speech and that focusing occurs in either the second or third generation after initial in-migration (Kerswill and Williams, 2000:67-71).

Trudgill defines simplification as a process that leads to an increase in morphophonemic regularity (1986:98). Simplification during koinéization may, in fact, be viewed as a combination of three related processes (Trudgill, 2009:100): the regularisation of regularities; an increase in morphological transparency; a loss of redundancy or a reduction in the repetition of information. Allophonic reduction is a prime example of simplification, leading to the attrition of positionally conditioned variants during dialect mixing. Hornsby, for example, found that lax allophones of /i/, /u/ and /y/, namely [ɪ], [ʊ] and [ʏ], that occur in closed syllables have become obsolescent during dialect contact in Avion, northern France (2006:98) (see Sections 1.2 and 1.4).

1.3.3. REGIONAL DIALECT LEVELLING AND KOINÉIZATION

In order to distinguish between the processes of RDL and koinéization, the researcher must consider the type of community involved in a given change since there is ample evidence that the rapidity and nature of change is linked to social structure (Kerswill, 2003:224). For example, if the community has high levels of in-migration from elsewhere, we might expect changes to be a result of koinéization whereas if the population of a given area is relatively stable but with high levels of contact between the speech community and people from elsewhere, we might expect to find more widespread dialect levelling characteristic of RDL. Examining and classifying the speech community is more difficult than identifying dialect-

geographical evidence because our descriptions of speech communities are incomplete and it is not always immediately obvious how community typology relates to the question of diffusion and levelling as change processes (Kerswill, 2003:224).

To distinguish between RDL and koinéization, it is always necessary to consider all possibilities when deciding on the focusing mechanisms that are driving a given linguistic change and, indeed, some changes are a result of multiple phenomena acting together. For example, children in Milton Keynes may have adopted TH-fronting because it is diffusing hierarchically from London; it is occurring at a pan-regional level throughout the southeast of England; or it involves simplification of the phonological inventory. Levelling ‘proper’ initially promoted the retention of majority variants during koinéization such as south-eastern [æu̯] for the MOUTH diphthong but the [æu̯] variant has since been variably replaced with [au̯] as Milton Keynes participates in the general southeastern trend. This is evidence for pan-regionalisation as Milton Keynes becomes more like the geographically contiguous varieties around it. This general southeastern trend may also be reinforced, in Milton Keynes, by the [au̯] variant diffusing hierarchically from London (see Section 1.3.1.3). Whichever focusing mechanism process began these changes, the others will almost certainly have encouraged their spread and, therefore, it is possible for both RDL and koinéization to take place side by side within a given geographical area.

1.4 CASE STUDY: HORNSBY (2006) *REDEFINING REGIONAL FRENCH*

Hornsby's study examines koinéization within a dialect contact and dialect loss framework and aims to explain the emergence of *français régional* in Avion, northern France, from contact between Picard and French. This notion of dialect contact varies somewhat from definitions advanced by other contemporary linguists in the field of language obsolescence (see Section 1.2) but Hornsby maintains that 'where the contact varieties are closely related, as in the case of Picard and French, the threatened variety may 'die' as a result of convergence with its more prestigious rival, as local features are gradually replaced by those of the standard or dominant variety' (2006:2). If we accept Hornsby's argument that attritted Picard is a dialect of modern French, then this study allows us to gain some important insights into the focusing mechanisms active in the formation of RF during koinéization, by explaining the retention of non-standard Picard forms in the RF of older speakers and their subsequent loss in the speech of the younger generations.

Levelling 'proper' appeared to be the best explanation for the survival of some Picard features in the RF of older speakers. Hornsby examined the relative vitality of non-standard features by investigating their attested geographical distribution in the *Atlas Linguistique de la France* (ALF) and the *Atlas Linguistique et Ethnographique Picard* (ALEP). Hornsby presents isoglosses for each variable under investigation and argues that the variables fall broadly into four groups: variants distributed widely throughout the north and west of France, e.g. 'elle' [al] for standard French⁷ (SF) [ɛl]; majority variants in the Picard and Norman area, e.g.

⁷ Note that Hornsby uses the term 'standard French' to refer to both the standard prescriptive norm and the northern statistical norm, 'supralocal French' (see Section 2.1.4.1).

‘ça’ [ʃa] for SF [sa]; majority variants in the Picard area, e.g. ‘on’ [ɛ̃n] for SF [ɔ̃]; variants only present in the Nord *département* and at isolate points, e.g. [-o] or [-ɔt] imperfect and conditional endings for SF [-ɛ] or [-e] as in ‘ils étaient’. These categorisations were then compared to the percentage scores for each variant in Avion RF on the assumption that, since most in-migrants to Avion came from the north of France, the variable distributions in the atlas data would be representative of the contributory varieties in the dialect mix. The ‘elle’ [al] variant was shown to enjoy a wide distribution in the linguistic atlases (in that it was present in much of the north of France), and this variant was, in fact, retained with the highest frequency in the RF of older speakers. At first glance, levelling ‘proper’ appeared to have promoted the retention of a majority form in the emergent koiné, but Hornsby notes that this variant is lost in apparent time, with young speakers hardly using the form at all (2006:94). For all other non-standard variants, however, the relationship between their area of distribution in linguistic atlases and vitality in emergent RF was unclear. For example, the pattern that emerges from analysing the ALF distribution data is that forms such as unpalatalised /k/ and /g/ as in ‘vache’ [vak] for SF [vaʃ] and ‘jardin’ [gardɛ̃] for SF [ʒaʁdɛ̃], which are attested throughout the Picard and Norman area, have only vestigial status in RF. These findings suggest that while levelling ‘proper’ may favour the adoption of majority dialectal variants during koinéization, it is not in itself enough to ensure their long-term survival in RF (Hornsby, 2006:97). Younger generations were shown to have adopted many variants that were diffusing hierarchically from Paris, such as word-final cluster simplification, ‘juste’ [ʒys] for SF [ʒyst]. The changing nature of RF over time

appears, therefore, to be a result of the processes of supralocalisation or RDL (see Section 3.1.1.), in that both levelling ‘proper’ and geographical diffusion are (consecutively) active during its formation.

Many of the changes observed in Avion RF appear to be motivated by simplification in that they generally reduce the number of rules that an outsider needs to learn (Hornsby, 2006:97). For example, Hornsby found evidence of paradigm simplification in the Avion data, identifying three successive reduction levels in the simplification of the Picard plural [-t] paradigm for imperfect and conditional endings. The first level of attrition involved the first, second and third person imperfect endings, [-ɔm], [-ɛt] and [-ɔt], being reduced to [-ɔt] for all plural persons, e.g. ‘nous ravisommes’ [-ɔm] for SF ‘nous regardions’ [-jɔ̃], ‘vous ravisettes’ [-ɛt] for SF ‘vous regardez’ [-je] and ‘ils ravisottent’ [-ɔt] for SF ‘ils regardaient’ [-ɛ] or [-e] became ‘nous ravisottes’ [-ɔt], ‘vous ravisottent’ [-ɔt] and ‘ils ravisottent’ [-ɔt], respectively. Following this, the plural marker gave way to the unmarked form [-o], with noticeably fewer speakers using [-ɔt] than [-o], e.g. ‘nous ravissot’ [-o], ‘vous ravissot’ [-o] and ‘ils ravissot’ [-o]. Eventually, the non-standard ‘nous’ and ‘vous’ forms were eliminated altogether in favour of SF [-jɔ̃] and [-je]: Hornsby interprets this as the loss of a dialect rule which presented a morphological complication to learners because the reduced [-o] forms, for ‘nous’ and ‘vous’ conjugations did not exhibit a one-to-one correspondence with SF forms. For this reason, these non-standard forms have been ousted in favour of a rule that simply substitutes one frequently occurring Picard form for a standard equivalent, i.e. replacing SF [-ɛ]/[-e]

with [-o] in the third person plural form alone. Based on this observation, Hornsby notes that changes that make RF more easily ‘learnable’ may not necessarily make it ‘simpler’ in absolute terms: RF appears to have been simplified relative to SF with non-standard forms bearing a one-to-one correspondence with the standard being retained.

Hornsby provides further evidence for ‘relative’ simplification in RF, showing that the most striking difference between obsolescent variants and those that exhibit vitality was that, for the latter, there existed a one-to-one isomorphic correspondence between the non-standard variants and their SF equivalents. For the non-standard variants that are maintained during focusing, an outsider is said to be able to learn a simple, exceptionless rule such as ‘for SF /A/, the rule is ‘velarize and round /A/ when it occurs word-finally’’ (2006:100), e.g. ‘pas’ [po] or [pɔ] for SF [pa]. The obsolescent variants, however, are said to present the SF speaker with a highly complex task. For example, if an outsider hears forms such as ‘tellement’ [telmẽ] for SF [telmã] or ‘sentir’ [sẽtir] for SF [sãtir], they might deduce a rule such as ‘replace SF /ã/ by [ẽ]’ but [ẽ] also corresponds to SF *on* /õ/ in the third-person indefinite pronoun, e.g. ‘in [ẽ] ravisse’ for SF ‘on [õ] regarde’, and another set of items require the same nasal vowel as in SF [ã] (Hornsby, 2006:100), e.g. ‘chanter’ [kãte] for SF [jãte]. There was some evidence to suggest that frequently occurring (and therefore more memorable) lexically conditioned non-standard variants can offer greater resistance to dedialectalisation, at least in the short term, e.g. ‘dans’ [dẽ] for SF [dã].

To a certain extent, the koinéization model, implies that the two principal focusing mechanisms – levelling ‘proper’ and simplification – work in tandem to reduce the number of available variants in the dialect mix. While this is often true, Hornsby shows that it is possible for the two processes to conflict. For example, the use of the majority morphological variant ‘elle’ [aɪ] was favoured by levelling ‘proper’ in the speech of older RF speakers but this variant has since been lost because it was an isolated exception and did not have an isomorphic relationship with the SF variant: ‘elle’ [aɪ] was not simpler from a SF perspective in that it did not involve a rule such that ‘SF [ɛ] is replaced by [a]’. Another example involves a rule whereby ‘vowel + [j]’ in SF is replaced by ‘vowel + [ɪ]’ locally, e.g. ‘travail’ [traval] for SF [travaj]. The non-standard variant ‘vowel + [ɪ]’ was widely distributed in the atlas data but its acceptability in SF is problematic because it creates the possibility of homonymic clash in word-pairs such as ‘bail/bal’, ‘rail/râle’, and ‘maille/mal’. Examples such as this lead Hornsby to the conclusion that where the processes of levelling and simplification conflict, relatively simpler variants are more likely to survive the reduction/focusing process in the long term (2006:106).

On the other hand, the focusing mechanisms may work in harmony together. Hornsby states that both levelling and simplification together account for the emergence of the most well-known northern RF feature, the use of velarised and rounded /A/ variants in word-final open syllables. Pooley suggested that these velarised rounded variants resulted from compromise or ‘fudged’ variants between Picard substrate items ending in /-o/, e.g. *bos* [bo] (‘bois’), and their SF equivalents

ending in /-wa/, e.g. ‘bois’ [bwa], resulting in RF variants such ‘bois’ [bwo] or [bwɔ] (1996:129). Hornsby views dialect contact as leading to the generalised use of intermediate variants in RF for all SF word-final /-A/, rather than being restricted to the very narrow phonolexical set in which Picard /-o/ and SF /-wa/ correspond (2006:106). The RF variant is attested over a large area of northern France in the ALF, promoting its usage, via levelling ‘proper’, as a majority local form in the dialect mix. Additionally, an easily learnable, regular and exceptionless phonological rule appears to have been favoured by simplification: ‘replace word-final open syllable [-a] with [-ɔ]’. Thus, rather than competing mechanisms, the retention of raised rounded /A/ variants in northern RF can be seen as a result of both levelling and simplification acting in a similar direction (Hornsby, 2006:106) (cf. Section 1.3.3).

Finally, Hornsby notes that changes in social network structure may explain alternations between the levelling ‘proper’ and simplification mechanisms, with high-contact favouring simplification and low-contact favouring levelling.

In summary, evidence for levelling ‘proper’ and simplification was evident in Avion RF, with the former promoting initially the retention of geographically widespread northern dialectal forms. Subsequently, however, simplification was shown to be favoured in the dialect mix resulting in the retention of only those non-standard forms which exhibited one-to-one correspondences with their standard equivalents. Hornsby’s Avion data also showed evidence for RDL, as younger speakers adopted large-scale non-standard supralocal forms diffusing from Paris. This provided additional support to Kerswill’s (2003) claim that the RDL and koinéization models of language change may act in tandem (see Section 1.3.3).

1.5 CHAPTER SUMMARY

This chapter has presented various contact situations in order to identify the mechanisms or processes of change active in each context. It began by discussing changes that may occur when two languages come into contact, where, over time, varying degrees of bilingualism may permit structural features of one language to transfer into another. The duration over which this contact occurs as well as the structural similarity between the languages involved was shown to condition the changes that may occur as well as the rate of change. These contact-induced changes were discussed in particular with specific reference to shift-induced contact where transfer was seen to occur primarily at the phonological and syntactic levels. Flege's SLM was also presented focusing on the L1-to-L2 transfer of phonological and phonetic features: the processes of equivalence classification and new category formation were shown to condition the nature of interference taking place during language contact.

The second section discussed the structural attrition that may occur within the obsolescent language. The importance of analysing change within the dying variety was highlighted because the rate and amount of change that may occur is accelerated by obsolescence to such an extent that, over a short period of time, the obsolescent language may diverge greatly from historical representations of its territorial vernacular. Any study examining features that may be transferred, particularly from the obsolescent into the dominant language, must ensure that these features are still present in the contemporary variety of the dying language.

The changes that may occur in regional varieties that have emerged from language contact were discussed in Section 1.3. This discussion was primarily concerned with changes that may occur in the emergent variety of the dominant

language, after language shift and language contact has come to completion. During contact with contiguous and incoming dialects of the same language, localised dialects were shown to become more like those around them and more like other regional dialects over a large geographical space. While levelling ‘proper’ was seen to be the primary mechanism motivating the attrition of local features via pan-regionalisation, RDL was determined to be the result of a combination of both levelling ‘proper’ and geographical diffusion. In the second dialect contact scenario, in which contact results from high levels of in-migration to a region, koinéization was advanced as the process that leads to the birth of a new dialect from the dialect mixing that occurs, comprising the focusing mechanisms of levelling ‘proper’ and simplification. Evidence from dialect contact situations in northern England and northern France showed that, while RDL and koinéization are generally considered to be separate phenomena, they may occur alongside each other for a given change or in a given contact situation.

CHAPTER 2

LANGUAGE CONTACT AND DIALECT CONTACT IN BÉARN

« La France et le Béarn, dit-on, sont deux royaumes distincts..., le Béarn est lié à la France à peu près comme l'Irlande à l'Angleterre. »

(Victor-Pierre Dubarat, *Document sur Betharam*, 1900)

Language contact between French and Béarnais, the indigenous language of Béarn, is hypothesised to have resulted in a distinct contemporary variety of French in the region. This chapter will examine the sociohistorical situation within which language contact has taken place and the linguistic systems of each of the varieties in contact. It will also consider dialect contact between the emergent variety of RF in Béarn and other incoming and contiguous varieties of French.

This chapter begins by discussing externally the evolution of the contact varieties, Béarnais and French, from Vulgar Latin as well as the history of French within the region, focusing on the process of language shift which has led to the obsolescence of Béarnais under pressure from French. The sociolinguistic characteristics of modern Béarnais speakers are then presented, followed by an overview of the terminological ambiguity associated with many of the designations used to refer to language in this thesis and of the social arena within which these ambiguities have come to exist.

The second section provides a detailed phonological description of Béarnais, comparing it along the way to standardised Occitan norms and the phonologies of

both standard and supralocal French in order to identify the variants that have the potential to transfer during language contact. The third section describes changing RF phonologies in Gascony and the south of France more generally over the course of the twentieth century, drawing on a number of previous studies of southern RF.

The bases for the two empirical studies to follow are outlined in the final two sections. The variables to be examined empirically are presented for each of the languages and dialects in contact, followed by the specific hypotheses arising from the theoretical literature reviewed in Chapter 1. For the language contact study, which will examine the linguistic mechanisms that give rise to the genesis of RF, the predictions of the SLM concerning phonetic and phonological transfer from Béarnais into French are outlined in detail. The possible outcomes of dialect contact between the RF of Béarn and the varieties of French with which it has been in contact are then discussed. Particular attention is paid to features unique to the RF of Béarn, which are potential instances of ‘substrate residue’. In some cases the complex phonetic and phonological parallels and differences mean that different outcomes would be expected from the different mechanisms of change operating in the alternative RDL model (levelling and diffusion); in others it will be seen that differentiating between these mechanisms is less straightforward.

2.1. SOCIOHISTORICAL SETTING

This section begins with a discussion in broad terms of the dialectal fragmentation of Gallo-Romance in order to situate the varieties in contact in terms of their historical development from Vulgar Latin. The history of the presence of French in Béarn is also presented focusing largely on the ways in which its imposition as the national language of France has affected Béarn, and its ancestral language, Béarnais, in quite

a different manner than elsewhere in France. Following this, the status of Béarnais in the twentieth century is discussed, providing a profile of the speech community. Finally, this section discusses some terminological issues associated with the contact varieties: the definition of ‘standard’ French; the disparity between the linguist’s definition of ‘dialect’ and the value-laden use of the term *dialecte* in France; the status of Béarnais as a dialect of Occitan.

2.1.1 DIALECTAL FRAGMENTATION IN GALLO-ROMANCE

By the tenth century A.D., the varieties descended from the Vulgar Latin spoken in Gaul had become strongly diversified along regional lines. While this regional diversity is, to a certain extent, attributable to the settlement of large numbers of non-Latin speaking migrants in Roman Gaul during the fifth and sixth centuries, Lodge notes that varying rates of romanisation in the territory and contact between Latin and various indigenous substrate languages, such as Gaulish or Aquitanian languages, meant that even before the Germanic invasions, the Latin spoken in Gaul was not uniform (1993:79). Hawkins notes that these external influences led to the development of three broad dialect areas and within those dialect areas, the development of sub-dialect areas (1993:58). The most significant division within Gallo-Romance is between the dialect area in the south, *langue d’oc*, and the dialect area in the north, *langue d’oïl*, with a third, eastern, dialect area, ‘Franco-Provençal’, often said to constitute a transition zone. These dialectal divisions have persisted into modern times and Lodge notes that ‘a comparison of the geographical distribution of regional forms found in medieval texts with their distribution charted onto modern dialect atlases shows a remarkable degree of stability’ (1993:71). The main dialect and sub-dialect areas are illustrated in Figure 2.1. The transition zones between the

langue d'oc and *langue d'oïl* areas are not clear-cut (Rickard, 1974:25), but at the extreme ends of the *oc/oïl* continuum the dialects of the north may be considered as different from the dialects of the south as modern French is from modern Spanish (Hawkins, 1993:58) and differences between them are evident at all levels of linguistic structure.

Figure 2.1. The Gallo-Romance Dialects (from Offord, 1990).

The modern *langue d'oc* dialect area covers thirty-one French *départements* and extends beyond France's national borders into Spain and Italy (Laroussi and Marcellesi, 1993:90). The southern *langue d'oc* area is commonly divided into six main dialects that can be seen in Figure 2.2: Gascon in the southwest including the Béarnais and Aranese sub-dialects; Central Languedocian; Limousin and Auvergnat in the north of the *oc* region; Provençal in the southeast including the Nissart sub-dialect; Vivaro-Alpin or Alpin Provençal above the Provençal region. Bec (1963) sees these six *langue d'oc* dialects as forming three supra-groups: Southern Occitan (Languedocian and Provençal); Northern Occitan (Limousin, Auvergnat and Vivaro-Alpin); Gascon stands alone.

Figure 2.2. The *langue d'oc* dialects (from Blanchet and Schiffman, 2004).

Within the *langue d'oc* area, Gascon is often singled out as a special case because it contains strongly marked regional features that are not found in any other dialects (Walter, 1988:153). Indeed, Bec calls Gascon ‘un lengatge estranh’ (1963:48). Linguistic Gascony stretches from the Pyrenees to the Atlantic Ocean and from the Garonne river to the area around Toulouse (Bec, 1963:48) with the exception of a small historically Basque-speaking area in the extreme southwest (see Figure 2.3). The explanation as to why Gascon contains highly distinct linguistic features has been much debated. Lodge notes that numerous factors seem to be at play: the pre-Latin Aquitanian (rather than Gaulish) substratum; the post-Latin Basque superstratum resulting from the Basque invasion of the area between the Garonne and the Pyrenees from the sixth to the ninth centuries; close communication networks with Romance-speaking populations south of the Pyrenees (1993:68).

Figure 2.3. Linguistic Gascony (from www.conservatoiregascogne.org).

Béarn is the historically Romance-speaking part of the modern-day Pyrénées-Atlantiques *département* (see Figures 2.4 and 2.5). The *langue d'oc* variety historically spoken in Béarn is commonly referred to as Béarnais, and is a sub-dialect of Gascon. The number of Gascon speakers in southwestern France increases steadily from north (Bordeaux) to south (the Pyrenees) and because Béarn is the area of linguistic Gascony with the highest recorded number of Gascon speakers (cf. Moreux, 2004), Béarnais may be considered the principal surviving dialect of Gascon, and has thus become largely synonymous with it. Jean Lafitte describes the relationship between Béarnais and Gascon in romantic terms: 'le gascon, une langue à part entière, le béarnais, âme du gascon' (1996:1).

Figure 2.4. The Pyrénées-Atlantiques *département* of France (from Wikipedia Commons).

Figure 2.5. The Pyrénées-Atlantiques *département*: Béarn and the Basque Country (from Wikipedia Commons).

2.1.2 FRENCH IN BÉARN

From as early as the twelfth century A.D., all official documentation in Béarn was written in the local language, Béarnais, rather than in Latin (Keller, 1985:65). Béarnais was thus firmly established as the prestige language at this time when official documentation written elsewhere, in the geographical space we know today as France, was largely written in Latin. Despite the predominance, elsewhere, of Latin in writing over all territorial vernaculars until the sixteenth century, the

presence of French in Béarn can be attested as far back as 1387, when Gaston Fébus, Count of Foix and Viscount of Béarn, wrote his *Livre de Chasse*. However, Fébus notes in the epilogue that French is not his mother tongue and apologises for any errors in his writing: ‘Et aussi ma langue n’est pas si bien duite de parler le franssois comme mon propre langayge’ (Tucoo-Chala, 1976:171). He wrote many other works primarily in Béarnais and, at this time, French was almost unheard of in Béarn and was certainly far from exerting any threat to, or competing in any way with, Béarnais.

In 1539, Francis I signed the *Ordonnances de Villers-Cotterêts* into law, one provision of which was to discontinue the use of Latin in official documentation within the geographical area governed by the French crown. The result was that over the 1540-1580 period, a very specific type of bilingualism⁸ developed in many parts of the territory which followed a simple formula: ‘le français est employé, quand on écrit, et l’idiome local, quand on parle’ (Brun, 1923:5). All official documentation, in the territory under French rule, was translated from Latin into French during this forty-year period. The implications of this for the largely illiterate masses were minimal and the majority continued to speak their local language variety. At the time of the *Ordonnances*, Béarn was a politically sovereign state, forming part of the *Royaume de Navarre*, and thus the legal stipulations of the *Ordonnances* did not impose any obligation. In the sixteenth century, official documentation, in Béarn, continued to be written in Béarnais. For example, the *Fors* (constitutional legislature) were printed in Béarnais in 1552 (Brun, 1923:27). The queen regnant of Navarre, Jeanne d’Albret, mother of Henri IV of France, demanded that all judicial acts,

⁸ The question of whether this type of bilingualism constitutes diglossia is beyond the scope of the present discussion. There is evidence to suggest, however, that even in the modern era, closely related varieties, such as French and Picard, represent separate grammars for bilingual speakers (Villeneuve and Auger, 2013). This is at odds with Hornsby’s (2006) view which considers modern-day French and Picard to be dialects of the same language.

patents and official documentation be written in Béarnais (Brun, 1923:15) and, in 1568, that Catholic mass be given to the population in Béarnais (Keller, 1985:68). Despite this resistance to French at an official level in Béarn, a series of historical events took place resulting in situations favourable to its use in many domains. Jeanne d'Albret converted to Protestantism and introduced it to the region in the late sixteenth century. This introduction of the protestant faith involved high levels of immigration to Béarn from Paris. The protestant preachers spoke French, by virtue of their regional origins and their relative education, and the nomadic nature of their work, spreading their word throughout the region, resulted in widespread contact between French and Béarnais. While it is almost certain that the nobility were using French during the protestant reform, there is evidence to suggest that the general population may have engaged in the protestant faith through Béarnais (Keller, 1985:69).

Henri IV, *Roi de Navarre*, succeeded to the French throne in 1589. Following his succession, he granted continued sovereignty to Béarn and it thus remained an independent state, separate from France. Despite Béarn's independence, the reign of Henri IV (1589-1610) was characterised by a rise in the use of French in official acts and documentation. The alternations in usage between French and Béarnais, in Béarn, were relatively infrequent with Béarnais remaining the dominant language. Béarnais remained the official language of the state and of address to the state or to those in authority and undoubtedly the language used in everyday communication by the masses. The *Fors* were again printed in Béarnais in 1602. By this stage, the rest of the south of France had renounced written usage of the local idiom in favour of French, a process almost certainly accelerated by the introduction of the printing press (Brun, 1923:27).

The seventeenth century heralded a large number of political reforms that affected both national (Béarnais) and linguistic norms in Béarn. In 1610, with the succession to the French throne of Henri IV's son, Louis XIII, the status of Béarnais as official language of the sovereign state suffered as a result of the political unity with the French Kingdom. In 1620, Louis XIII incorporated Béarn into France by signing the *Édit d'Union* and ordered that all 'procédures de notre dite cour de Parlement soient expédiés en langage françois' (Brun, 1923:32). While this legislation marks the shift from Béarnais to French at the court and for officialdom, Brun states that it is almost certain that at this time southern populations, beyond the court, were completely ignorant of French and unable to use it (1923:6). In addition to this, sufficient evidence exists to suggest that the nobility and the upper classes in Béarn were using French though their mother tongue was Béarnais (Brun, 1923:19; Keller, 1985:70). As a result of this, the people in Béarn who were speaking French were still highly dependant on Béarnais and spoke a French that was highly influenced by their mother tongue (Keller, 1985:90).

From 1620 onwards, French was the official language of Béarn but there is evidence to suggest that even for officialdom the language shift was far from complete for a substantial time period following the incorporation of Béarn into France. The *Fors* were re-printed in Béarnais throughout the seventeenth and eighteenth centuries (1625, 1673, 1715, 1723, 1781) (Keller, 1985:70). Written documentation in the rest of Gascony, Provence and Languedoc had been in French since 1540. While writing in French gradually began to overtake Béarnais during the eighteenth century, the amount of documentation written in Béarnais was substantial, particularly in more rural areas such as the Pyrenean valleys (Brun, 1923:52) and Béarnais remained the language of oral communication and some documentation

until at least the eve of the Revolution. Brun states, in discussing the shift from Béarnais to French, ‘et ce dénouement a été préparé et consommé non par l’intrusion de la monarchie française en Béarn, mais par celle des Béarnais dans les affaires de France’ (1923:17). The incorporation of Béarn into France did not, in and of itself, encourage the Béarnais people to speak French; in fact, it had little effect on the language of everyday communication. However, the increasing contact with Paris indirectly encouraged those who looked outside of the region to use French at the expense of Béarnais.

Upon the publication of the *Convocation des États Généraux* in 1789, many Béarnais nobles and bourgeois expressed nationalistic (Béarnais) sentiments, stating that the *Édit d’Union* (1620) was illegal as it had never been ratified by Béarn and had been imposed by force (Tucóo-Chala, 2009:115). In fact, some notaries continued to write in Béarnais until 1815. However, from 1815 onwards, ‘les Béarnais se contentèrent de suivre, toujours avec retard et avec modération, les impulsions politiques venues de Paris’ (Tucóo-Chala, 2009:15). Post-Revolution, there is very little information available on the subsequent stages of language shift in Béarn. Keller discusses the increase of literacy in French as an indicator of the rate of decline of Béarnais over the course of the nineteenth century (1985:71). Baron Dupin’s (1826) *La carte de la France scolaire*, indicates that, in Pyrénées-Atlantiques, only one in fifteen boys of school-going age had received any formal education suggesting that at most 6% of the youngest generation *may* have spoken French. Victor Drury’s (1864) similar survey found that between 70% and 80% of children attending school had some knowledge of French. This does not, however, account for those children who were not attending school.

The eventual shift from Béarnais to French was supported by the *Loi Jules Ferry* (1881) and its introduction of national free and compulsory education in 1881-1886. The period immediately following the *Loi Jules Ferry* was not necessarily characterised by large levels of fluency and literacy in French among the general population. Weber takes the end of the First World War as the watershed in the fortunes of the traditional Romance dialects and regional languages of France (1979:79), the shared experience of conscription having raised national consciousness and underlined the value of French as a *lingua franca* (Hornsby, 2006:125). Moreux and Moreux (1989) note, however, that though the first signs of disaffection with Béarnais, in rural areas, appeared in the generation born during the First World War, the predominant daily use of French in Béarn began only with the generation born during the Second World War. The general shift from a rural to an urban-focused society in the twentieth century also supported the use of French in everyday communication. There are indications that the vitality of Béarnais continued for some time, particularly in rural areas. For example, Pottier's (1968) *Carte du bilinguisme en milieu rural* (see Figure 2.6) shows the majority of the rural areas of the Midi exhibiting a 'bilinguisme usuel' while only the Pyrenean borderlands and contiguous areas are credited with the label 'bilinguisme intense' (Kristol and Wüest, 1985:2). The exact intensity of bilingualism in Béarn is open to interpretation. We can glean from this, however, that language contact in Béarn continued up until the mid-twentieth century, at least in rural areas. Indeed, in the mid-1980s, Kristol and Wüest, proclaimed that there were several rural sites in Béarn where intense bilingualism was still found and where we can study the language of the last generation of native speakers who arrived at school aged five, unable to speak French (1985:4).

The contact period between Béarnais and French began on a large scale between 1826-1864 and continued, with Béarnais being transmitted as L1, up until some time between the two World Wars, a period of approximately eighty to one hundred years. Many of the last generation of Béarnais-French bilinguals are thus still alive today and in the case of these speakers, of course, language contact has persisted until the present day. The cessation of intergenerational transmission that occurred during the twentieth century, and concomitant completion of language shift to French, can thus be observed in apparent time, particularly in the urban and semi-urban areas of Béarn.

Figure 2.6. Bilingualism in the autochthonous languages of France (from Pottiers (1968) in Pooley (2006:341)).

2.1.3 A SOCIOLINGUISTIC PROFILE OF THE BÉARNAIS SPEECH COMMUNITY

From the late nineteenth century onwards, and indeed over the course of the twentieth century, Béarnais found itself in an increasing state of language obsolescence. While there is some evidence to suggest that the last generation of native speakers were born in rural areas up until the eve of the Second World War (Moreux, 2004:25), the state of the language in the latter half of the twentieth century displays the characteristics described by language obsolescence models: the language not being taught to children in the home; the number of speakers declining very rapidly, the entire population being bilingual, with French preferred in almost all situations; little or no literacy in the language (Bauman, 1980). In Dorian's terms, Béarnais is in a situation of 'gradual death' (1981:107), but this definition specifies, however, an age-governed proficiency continuum in the obsolescent variety: young speakers tend to be least proficient and older speakers most proficient with at least one generation of semi-speakers. Béarnais, however, has no marked age-governed proficiency continuum: native speakers are relatively easily locatable amongst Béarn-born inhabitants over the age of sixty-five in rural areas, but below this age, they are much more difficult to find and very few speakers are to be found under the age of forty⁹.

In the entire historically Gascon-speaking region (see Figure 2.3), the number of speakers, at all levels of proficiency, varies from 3% of the population in Bordeaux to 30% in Béarn, approximately 500,000 speakers in total¹⁰ (Moreux, 2004:25). These numbers include fluent native speakers and semi-speakers. In some

⁹ See Jones (2001:3) for a parallel situation in Jersey Norman French.

¹⁰ All speaker numbers are taken from Moreux (2004) who uses three reports entitled *Pratique(s), (présence) et représentations de l'occitan (ou langue occitane)* published between 1994 and 1997 after surveys were undertaken for the *Conseils Généraux* of the Pyrénées-Atlantiques *département* and for the Aquitaine *Conseil Régional*.

areas of Béarn (see Figure 2.6) there are said to be many native speakers, an ‘enormous pool of people with passive language competence’ (Moreux, 2004:29) and some parents who still transmit the language to their children. For the Béarn region, Moreux cites 16% of people aged over fourteen as saying that they spoke Béarnais well (fluent speakers) and 14% as saying that they spoke a little, giving a total of 30% for speakers of all levels of proficiency, or about 75,000 speakers. If we cautiously examine only the fluent speakers (approximately 40,000 speakers), we must note that over 50% of these speakers are over the age of sixty and rural-dwellers and only 3.5% are between the ages of fourteen and twenty-four. All of the Béarnais speakers noted by Moreux were born in Béarn or in linguistic Gascony with INSEE (1994) showing that, in the late twentieth century, only a little over half of the people living in Béarn over the age of fourteen were actually born there. Finally, we may note that in Pau and its surrounding areas, where almost half of the population of Béarn now lives, Béarnais is almost totally absent (Moreux, 2004:31). Any Béarnais speakers present in Pau are all over the age of fifty and a minority even in this age group.

Béarnais is spoken only in closed tight-knit networks, usually made up of older people, who are very emotionally attached to their language, but few of whom make it an ideological issue or are preoccupied by its future (Moreux, 2004:25). Béarnais is seen as a community-based and not a family-based language:

‘ce qui frappe, c’est que l’on utilise le béarnais avant tout dans les interactions sociales à l’intérieur de la communauté villageoise et que la famille n’est pas le lieu privilégié où on le parle le plus souvent, [...] le béarnais est la langue de la communauté restreinte.’

(Müller et al., 1985:103)

Kristol and Wüest (1985), referring to the domains of use of Béarnais, summarise the situation as follows: there are a limited number of domains where the language can be spoken, such as the market, for example, to the extent that using Béarnais in an

unfamiliar context, such as an interview, can violate the speaker's sense of appropriate setting. Béarnais is thus highly restricted in its domains of use, which reduces its 'functional load'¹¹ and underlines its status as a dying language.

Nowadays, grandparents, especially grandfathers, may teach their grandchildren playful uses of Béarnais. However, these grandparents, who now seek to transmit *some* Béarnais, were the same parents who were careful not to speak any Béarnais to their children to avoid the shame of them starting school 'sans comprendre un mot de français' (Moreux, 2004:37). Müller et al. (1985) observed that linguistic exogamy has been a major factor in driving language shift, in both rural and urban areas. In 1983, they observed that in Osse-en-Aspe, a small rural village in the Pyrenean *Vallée d'Aspe*, almost all of the non-Béarnais speakers had had at least one parent of non-Béarnais origin. By contrast, in families with both parents of Béarnais origin, intergenerational transmission was total for all informants surveyed. In the urban setting, notably in Oloron-Sainte-Marie, the largest town in western Béarn, and in Bédous, a large town nearby, non-transmission in families having two Béarnais-speaking parents was the cause of half the cases of monolingual French speakers, the other half being caused by linguistic exogamy (Müller et al., 1985). We must exercise caution in interpreting these results due to limited sample sizes and sampling techniques that targeted first language speakers, but they indicate that there was a clear rural-urban divide in relation to intergenerational transmission as recently as the 1980s. In many of the rare cases where intergenerational transmission occurred at home, it was often imperfect and a highly marginal endeavour.

¹¹ 'Functional load', is not used here in the same way as in functional phonology. It is used with the following meaning: 'a quantitative base to evaluate the notion of "power" of the languages in a society in order to distinguish between major and minor languages. The language that successfully functions in relatively more domains is considered to have a higher functional load' as specified in Pandharipande (2002:1).

Since the 1980s, some public schools and private *Calandretas*, immersion-education schools, have been offering bilingual education at primary school level. The language the children are taught at school, usually called Occitan, is said to be a ‘bit different from the one they might hear at home’ (Moreux, 2004:33). The Pyrénées-Atlantiques *département* (see Figure 2.5) has been particularly progressive in terms of promoting primary competence amongst the young (Moreux and Puyau, 2002:12). Of eleven *Calandretas* in Aquitaine (see Figure 2.7), eight were located in Pyrénées-Atlantiques¹² in 2002 (Coyos, 2004:180). The *Calandretas* provide children, in theory, with the opportunity to strengthen ties with older generations in the region even if the language that they are taught at school is different from the one they may hear at home. Some cases have been reported, however, where for reasons of unintelligibility, communication between generations has been impeded (Moreux, 2004:33; Moreux and Puyau, 2005:4). The effect of these bilingual schools on the linguistic competence of the younger generations is almost negligible with only 1% of children attending these schools in Pyrénées-Atlantiques, roughly 2,000 children in total. This situation is further aggravated by the fact that most of the *Calandreta* pupils in urban areas rarely speak Occitan outside of the classroom and are less motivated to do so after they have left primary school (Moreux, 2004:33).

¹² In the historically Basque-speaking region of Pyrénées-Atlantiques, labelled *Iparralde* (Northern Basque Country) in Figure 2.5, Basque-French bilingual immersion schools, called *Ikastolas*, are the Basque equivalent of the *Calandretas*.

Figure 2.7. Aquitaine Administrative Divisions (from www.service-public.fr).

2.1.4. LANGUAGES AND DIALECTS IN BÉARN: PROBLEMS AND PERSPECTIVES

The question of what constitutes a language and a dialect has been widely discussed among linguists, largely because it seems impossible to distinguish between these terms on the basis of linguistic structure alone:

‘Even if one rejects the flippant definition of a language as “a dialect with an army and a navy”, it is still undeniable that the distinction between language and dialect is primarily a sociological and psychological matter, rather than something that can be decided on purely linguistic grounds.’

(Matisoff, 1991:193, cited in Jones, 2001:40)

The notion of a language as being simply ‘a dialect with an army and a navy’ stresses the importance of political factors that lie behind perceived linguistic autonomy (Chambers and Trudgill, 1980:12) and, indeed, ‘language’ cannot be considered a particularly linguistic notion at all:

‘Linguistic features obviously come into it, but it is clear that we consider Norwegian, Swedish [and] Danish [...] to be single languages for reasons that are as much political, geographical, historical, sociological and cultural as linguistic.’

(Chambers and Trudgill, 1980:5)

Defining Norwegian, Swedish and Danish, that have a high degree of mutual intelligibility between them, as ‘languages’ subverts the traditional definition of a language as a collection of mutually intelligible dialects. While this definition of a language is not always applicable, as illustrated above, it is useful to characterise dialects as subparts of a macro-variety, or language, in order to provide a criterion for distinguishing between one language variety and another (Chambers and Trudgill, 1980:3).

From a linguistic perspective, the term ‘dialect’ refers to varieties which are grammatically (and perhaps lexically) as well as phonologically different from other varieties (Hawkins, 1993:57) in that speakers of the same ‘dialect’ have a shared set of speech habits with reference to another group who have a different set of speech habits and thus, speak a different ‘dialect’¹³. Chambers and Trudgill accept that standard varieties are as much a dialect as any other form of the language (1980:3) but the standard variety happens to have acquired the status of ‘official dialect’ in the country in which it was spoken (Hawkins, 1993:57). In being selected as the ‘official dialect’, these varieties may be said to have become languages, with such a transition highlighting the fact that the ‘language’ and ‘dialect’ definitions are intrinsically linked to socio-political phenomena. There is, of course, a distinction to be made between the linguist’s problematic attempts to define ‘language’ and ‘dialect’ and the popular, often value-laden, use of the terms. In common usage, speakers often use ‘language’ to refer solely to the standardised varieties based on a common belief that language homogeneity, as represented by the standard, is beneficial to society. This belief is referred to by Milroy and Milroy (1985) as the ‘ideology of the standard’

¹³ ‘Accent’ differs from ‘dialect’ in that it refers solely to pronunciation and therefore to a variety that is phonetically and/or phonologically different from other varieties. Chambers and Trudgill note, however, that ‘accents’ and ‘dialects’ frequently merge into one another without any discrete break (1980:5).

and by Houdebine (1995) as *imaginaire linguistique*. This subjective attitude towards the standard language is based on fictionalisations or rationalisations about the state of the standard language and its use. By contrast, ‘dialect’ may be employed in common usage to refer to: substandard or low status varieties associated with peasantry, the working class or other non-prestige groups of speakers; erroneous deviations from a standard language; varieties that have no written form, particularly those spoken in isolated parts of the world. These definitions of ‘dialect’ are generally negative and often seen as mutations of the standard variety or as separate language varieties that are inferior to the idealised standard.

2.1.4.1. WHICH STANDARD FRENCH?

In France, the popular use of the term ‘language’ almost exclusively refers to the standard French (SF) language. Houdebine (1995) sees the notion of SF as being born from a prescriptive and normative tradition, comprising an imaginary hierarchy based on a fictionalised representation of language. Such a SF language may be defined as the reference variety of French codified in grammars and dictionaries, such as *Le Petit Robert*, and propagated through the education system as the national language of France. Hornsby refers to SF, by this definition, as the prestige norm or *français normatif* (2006:78). Houdebine (1995) refutes the notion that *français normatif* exists in any real form because the French that is actually spoken in France is not a homogeneous entity but a rich collection of variant forms. This view, however, is not always shared by the general population who fail to recognise that the language they are actually speaking diverges from socially-constructed, idealised SF: ‘the problem is that only in some cultures does the standard language and the prestige language amount to the same thing’ (Milroy et al., 1994:352).

In this thesis, I use SF to denote the prescriptive norm, *français normatif*. On the other hand, supralocal French is a levelled (see Section 1.3) northern urban variety of French which is, in phonological terms, closely equivalent to what Carton et al. (1983) termed *français standardisé* (in opposition to *français standard*, in the normative sense). It is the variety of French used in urban settings in the area north of the Garonne and Massif Central, excluding the extreme peripheral areas to the east, the north and the Breton-speaking west (Armstrong, 2001:2). Supralocal French constitutes a statistical norm, in that it is the everyday speech form of the majority of the population in the northern two thirds of France which differs from SF primarily in relation to its phonology (Pooley, 2007:40). The regionally neutral supralocal variety of French has also spread southward into the northern *langue d'oc* regions, as illustrated in Figure 2.8, where the large white area represents a zone where regionally marked varieties are not used in towns.

Figure 2.8. The Geographical Spread of supralocal French in Urban Areas (from Pooley, 2006:385).

2.1.4.2. THE NOTION OF *DIALECTE* IN FRANCE

The term *dialecte* is used by linguists to denote the Gallo-Romance varieties that emerged from the fragmentation of Vulgar Latin in Gaul (see Figure 2.1) (Hornsby, 2006:21). In this case the language of which the Gallo-Romance varieties are *dialectes* would be Vulgar Latin. The term *dialecte* may also be used by linguists to refer explicitly to actual linguistic *dialectes de langue d'oïl* (e.g., *normand*, *gallo*, etc.) or *dialectes de langue d'oc* (e.g., *nissart*, *languedocien*, etc.). The popular use of the term *dialecte* may describe all of the Romance varieties of France that are not French; *langue d'oïl* varieties; *langue d'oc* varieties; *Ibero-Romance* (Catalan¹⁴); *Italo-Romance* (Corsican). The term *dialecte* has also become extended to include all languages spoken in France that are not French, including the Romance varieties and the non-Romance varieties (see Figure 2.9).

In popular usage, the term *dialecte* is often interchangeable with *patois* where the latter may also be used to emphasise the localised characteristics of the *dialecte*. Linguists tend to shy away from the term *patois* because of its pejorative connotations; non-standard, backward, countrified, etc. When it is used, it may denote a highly localised variety of a particular *dialecte*, often spoken in an area no larger than a single village (Hornsby, 2006:21). The term *patois* is also commonly used by speakers of local languages to refer familiarly to the variety they speak though it may be considered offensive when used by outsiders to the minority speech community. *Patois* is also used as the name for the Romance languages and the non-Romance languages, with both Breton and Béarnais speakers, for example, affirming that they speak *patois*.

¹⁴ The classification of Catalan as either Occitano-Romance (and thus Gallo-Romance) or as Ibero-Romance is a moot point amongst Romance Linguists.

Figure 2.9. The Regional Languages of France (from Wikipedia Creative Commons).

Another use of the term *dialecte* refers to contemporary varieties of French. This usage of the term is almost exclusively reserved for specialists and is not widely used by lay-speakers. This type of *dialecte* may refer to any grammatical (and perhaps lexical) and/or phonological deviation from the accepted norm for SF or, equally, with reference to the supralocal norm (cf. Pooley, 2007). By this definition, *dialecte* corresponds broadly to ‘dialect’ in the Anglo-Saxon linguist’s sense, though this usage has been slow to gain currency in France (Hornsby, 2006:21). Armstrong and Blanchet state that this definition of *dialecte* refers to contemporary regional or social varieties of French, which have evolved since the fairly recent diffusion and adoption of the official language by the whole population (2006:269).

2.1.4.3. BÉARNAIS DONC GASCON DONC OCCITAN: IDEOLOGICAL CONFLICT

The process of language shift often leads to the emergence of political campaigns or pressure groups, such as *Ofis ar Brezhoneg* in Brittany or *Conradh na Gaeilge* in

Ireland, which aim to call attention to the plight of their language and to demand revitalisation efforts. This section examines the militant discourses that, on one side, promote Béarnais as a language in its own right and, on the other, refute its autonomy and view Béarnais as a localised dialect of one particular language, Occitan.

In 1896, the *Escole Gastoû Fébus* was created and spurred a movement for the survival and development of the Gascon and Béarnais language and culture. The aim of this movement was to defend the specificity of Gascon against the predominant *provençal*¹⁵ glossonym that was widely used in the south of France as a blanket term for all *langue d'oc* dialects. The Fébusian movement was ‘very solidly Catholic, rural, conservative and nationalist [French], making only moderate regional demands involving no militant actions’ (Moreux, 2004:39). It gave rise to literary, journalistic and theatrical works and enabled these works to reach a larger public. The movement used the Béarnais spoken around Pau as a standard, created orthographical rules and developed the tools necessary for linguistic codification, namely a dictionary and a grammar (Moreux, 2004:39).

The Fébusian movement continued to promote Gascon and Béarnais up until the end of the 1980s, but after 1960, it had to compete with a new ‘Occitan’ movement which officially arrived in Béarn with the creation of the *Institut d’Études Occitanes* (IEO). The IEO had existed elsewhere in the south of France since the eve of the Second World War and differed from the Félibrige movement in Provence in its more radical regionalist demands and leftist tendencies, often going as far as

¹⁵ The Félibrige movement, led by Frédéric Mistral, began in Provence in 1854 with the aim of defending the language and literature of all *langue d'oc* dialects. For many centuries previous, the terms *provençal* and *lemousin* were often used to denote all *langue d'oc* dialects and due to the success of the Félibrige in the nineteenth century, *provençal* became widely used to refer to all Romance varieties in the south of France (including Catalan). Today, however, in specialist usage, Provençal refers specifically to the *langue d'oc* dialect historically spoken in Provence, southeastern France.

claiming independence and becoming extremely left wing after 1968 (Moreux, 2004:40). The Occitanist movement considers ‘Occitan’, the unifying name used to designate all *langue d’oc* dialects, including Gascon and Béarnais, to be a language. Occitan is said to imitate dominant languages by ‘constructing a large geographical language area encompassing the largest possible number of speakers which can penetrate institutional and educational domains at a large-scale regional level’ (Blanchet, 2010:2). The standardisation of Occitan began in the 1970s and the orthographical standard is based on medieval representations of central *langue d’oc* dialects together with some modern Languedocian. The resultant orthography is said to be so strange and complicated that ordinary speakers could not even recognise nor read the language that was supposed to be their own (Blanchet and Schiffman, 2004:8). Manzano sees this standardisation process and the name ‘Occitan’ as leading to an utter abstraction from what we know about *langue d’oc* dialects, an abstraction that presents a unified language which has never existed in the form advocated by the movement (2004:64). In the late 1980s and early 1990s, however, the presence of Occitanism was clearly visible in the public sphere and had already succeeded in occupying all of the, albeit limited, institutional, associative and media space that the central French government and the various regional governments had granted to militant linguistic movements in Gascony (Moreux, 2004:41). Occitan orthography was generalised to all domains in publishing and any activity receiving public subsidy such as educational textbooks, newspapers, magazines and bilingual road signs.

Over the past fifteen years or so, two reactions to the Occitan paradigm have emerged: ‘the first scholarly, and based on linguistic arguments, concerns all of Gascony (Gasconism). The second, more “grass-roots”, originated and spread mostly

in Béarn (Béarnism)’ (Moreux, 2004:45). In 1993, Jean Lafitte, a member of the IEO, along with several others, called Gascon ‘une langue à part entière’, not simply a ‘dialecte de l’occitan’ and began writing the *Dictionnaire du gascon moderne*. This modern Gasconism followed on from the ideology of the *Escole Gastoû Fébus* and, on the whole, refused any political involvement: it was not concerned with ‘taking on’ French centralisation. It did, however, campaign actively for the inclusion of Gascon in the *European Charter for Regional or Minority Languages* and indeed for the very ratification of the charter by the French state. Lafitte also founded an academic journal, *Ligam-DiGam*, which was written exclusively in Fébusian orthography. In fact, the largest publishing company in Gascony, *Éditions Pyrémone*, began to publish regularly in Fébusian orthography, thus ending the quasi-monopoly of Occitanist spelling in publishing.

In 2002, the Gasconist movement united with a Béarnist organisation, *Pays de Béarn et Gascogne* (PBG), founded in 1995 by Jean-Marie Puyau, to form the *Institut Béarnais et Gascon* (IBG). The members of the IBG originally demanded the right to name their own language, to preserve it as it was and to affirm their identity, not only symbolically, in orthography and bilingual signage, but also in economic terms. It was an openly anti-Occitanist organisation, campaigning for the use of the term ‘Béarnais’ to designate the language taught in *Calandretas* and for the inclusion of both Béarnais and Gascon in the *European Charter*. As with the *Escole Gastoû Fébus*, the IBG’s militancy does not extend beyond language and cultural awareness and rarely enters the political arena. In order to reach as many speakers as possible, the IBG uses the Fébusian orthographical conventions laid down by the *Escole Gastoû Fébus* in press and publishing. Since the Gasconist and Béarnist movements united against their common adversary, Occitanism, they have gained a certain

public visibility though they have not yet penetrated Occitan's educational and institutional monopoly (Moreux, 2004:5).

The Occitan slogan in Béarn is 'Béarnais donc Gascon donc Occitan' but, on the whole, native speakers reject this proposition (Moreux, 2004:45). On the other hand, the attitude of Occitanists towards native speakers is more complex. Some Occitanists admire the native speakers, or even envy them for their primary competence in the language, while others are reproachful towards the 'patois' speakers and resent parents who did not transmit their language and who do not support its revival (in the form of Occitan). In fact, Moreux (2004:45) states that because of this, the situation would be much easier, in terms of promotion/revitalisation, for the Occitanists if there were no longer any native speakers. Because of this apparent divide between the 'grass-roots' native speakers and the politically oriented militants, Blanchet states that from a sociolinguistic point of view, Occitan is not one language, with the exception of only a minority of intellectuals and militants who seek to gather or even unify various languages and dialects under one rubric (2004:151). The Occitanist militants are not completely ignorant of this ideological gap, and some Occitan organisations actually call the standardised Occitan they are using, 'Béarnais' either for strategic reasons or simply due to identity-based uneasiness in the region (e.g., *Ostau Biarnés*). The Béarnist militants, on the other hand, have attracted substantial support from native speakers in Béarn, due to the fact, one must assume, that they are largely apolitical and conservative rather than reformist. The Béarnist movement, it must be noted, is scarcely concerned with issues of revitalisation and is generally interested in the documentation and celebration of the speech of older native speakers: there is neither

active recruitment of younger members nor any concrete encouragement of intergenerational transmission.

Terminological ambiguity is also evident both within the education system and in documentation on language policy. At secondary level, Blanchet notes that there is a temptation in the offices of the *Ministère de l'Éducation Nationale* to deny the unity of *langue d'oc* under the Occitan rubric and to replace it with the notion of *langues d'oc* in the plural (2004:155). The latest manifestation of this temptation can be seen when *baccalauréat* students register for the Occitan examination where they must indicate which variety they wish to be examined in. Candidates for the CAPES *d'occitan-langue d'oc*, however, can be examined on texts and documents from any one of the *langues d'oc* varieties. There is, however, a general shortfall on the part of national language policy to recognise regional diversity in the same way within in the *langue d'oc* area. The most recent government report states that:

‘Les parlers de l’espace occitan, où certaines variétés, telles que *le béarnais*, *le gascon*, *le nissard*, ou *le provençal*, font l’objet de certaines *demandes de reconnaissance récurrentes*. Le rapport de 1999 [Cerquiglini] avait considéré que «l’occitan était la somme de ses variétés». La DGLFLF [Délégation Générale de la Langue Française et des Langues de France], pour sa part, considère que les variétés internes, *nommément désignées et reconnues*, ne remettent pas en cause l’unité de l’occitan, dont la dénomination retenue par l’Éducation nationale est *occitan-langue d’oc*.’

(Filipetti, 2013:15 [my emphasis])

While national language policy acknowledges the demands of localised movements, a polynomic or pluricentric model for the *langue d'oc* dialects is avoided. It seems that this avoidance is an explicit result of the difficulty involved in creating a satisfactory model for Occitan. Blanchet and Schiffman believe that the Occitan agenda is actually accelerating the ongoing language shift towards French because it does not have any forceful effect on the masses (2004:15). It is seen as being unable to reach ‘real’ people as it does not take account of the actual sociolinguistic situation in the south of France and has not set realistic goals for language

revitalisation with particular reference to speakers and attitudes. This is said to be because investigating how to bring about a genuine bottom-up revitalisation of Occitan would have meant having to accept the reality the movement was fighting against; ‘local dialects, no sense of language unity and common identity, influence of French within a bilingual society, loyalty to the local French variety of language and to France etc.’ (Blanchet and Schiffman, 2004:16). While it is clear that the ideological connotations associated with the terms ‘Occitan’ and ‘Béarnais’ are extremely different, and that each side continues to fight its cause, it seems that if a *langue d’oc* variety is to survive in Béarn, it will be artificial Occitan and its success will have been based on ousting the very language it claims to promote and preserve.

2.2 PHONOLOGICAL SYSTEMS: BÉARNAIS, OCCITAN AND FRENCH

This section provides a detailed description of the phonologies of Béarnais, Occitan and French focusing on oral vowels, nasal vowels, glides and diphthongs, and finally, consonants. The discussion includes etymological information on the evolution of all three varieties from Latin and, following this, a synchronic account of their modern-day structures.

2.2.1 PRELIMINARIES

This section outlines the orthographical conventions to be used throughout the present study and provides information regarding the tonic stress system in *langue d’oc* varieties.

2.2.1.1 ORTHOGRAPHICAL CONVENTIONS

Graphic standardisation is the main bone of contention between the Occitanist (IEO) and Béarnist (IBG) camps. The Occitanists make use of the ‘classical orthography’ while the Béarnists promote the use of the Fébusian orthographical system, with neither side accepting the other’s conventions. The following examples illustrate the differences between the orthographical systems (Boschung and Frick, 1985:145-146 [my transcription]):

Classical Norm

**“La vertat, ce dizon, n’ei pas tostemps bona a diser, mes n’ei pas
[la bɛr'tat | se 'dizen | nej pas tus'tem 'bunɔ wa 'dize | mes nej pas
tanpauc, sovent, plasenta a entènder”
tam'pawɔ su'ben | pla'zentɔ wa en'tende||]**

Fébusian Norm

**“La bertat, si disen, n’ey pas toustém boune à diser, méy n’ey pas
[la bɛr'tat | si 'dizen | nej pas tus'tem 'bunɔ wa 'dize | mej ne pas
tapòc, soubén, plasénte à entèner”
ta'pɔk su'ben | pla'zentɔ wa en'tene||]**

Standard French

**“La vérité, dit-on, n’est pas toujours bonne à dire, mais elle n’est
[la vɛʁite | ditɔ̃ | nɛ pa tuʒuʁ bɔ̃ na diʁ | mɛ jɛl nɛ
souvent pas non plus agréable à entendre”.
suvã pa nã ply zagɛjabl a ãtã:dʁ||]**

The primary differences between the classical and Fébusian orthographies include: /b/ is represented as *v* in Occitan (e.g., *vertat* [ber'tat] ‘vérité’) and as *b* in Béarnais (e.g., *bertat* [ber'tat]); post-tonic word-final /-ɔ/ is represented as *-a* in Occitan (e.g., *bona* ['bunɔ] ‘bonne’) and as *-e* in Béarnais (*boune* ['bunɔ]); /u/ is represented as *o* in Occitan (e.g., *sovent* [su'ben] ‘souvent’) and as *ou* in Béarnais

(e.g., *soubén* [su'ben]); /h/ (< Latin F) is represented as *f* (and pronounced as [f]) in Occitan (e.g., *finèstra* [fi'nɛstrɔ] 'fenêtre') and as *h* in Béarnais (e.g., *hièstre* [h'jɛstrɔ]); unpronounced word-final *-r* is used to indicate verb forms in Occitan (e.g., *diser* ['dize] 'dire') while this grapheme is absent in Béarnais (e.g., *dise* ['dize]).

The following are important conventions involving diacritic accents in both of the orthographies:

- (i) Both classical and Fébusian orthographies use the acute and grave accents with the same values as French, thus *é* and *è* indicate [e] and [ɛ] respectively, e.g., *elèye* [e'leje] ('choisir') in Béarnais and *bèlque* ['belge] ('belge') in 'Occitan'.
- (ii) Fébusian orthography represents [e] graphically in the following ways: *e* for pre-tonic [e] as in *espàrze* [es'parze] ('épandre'); *é* for tonic [e] as in *éth* ['et̃] ('lui'); *ɛ* for post-tonic word-final [e] as in *bràbɛ* ['braβɛ] ('brave'). The grapheme *è*, on the other hand, always represents tonic [ɛ], e.g., *nabèth* [na'βet̃] ('nouveau').
- (iii) Fébusian orthography uses *o* and *ou* to indicate [ɔ] and [u] respectively, e.g., *loc* [lɔk] ('lieu') and *lou* [lu] ('leur') in Béarnais. In Occitan, these phones are represented by *ò* and *o*, e.g., *luòc* [lwɔk] ('lieu') and *lor* [lu] ('leur'). We may also note that in Fébusian orthography, *où* is often used

to represented tonic [u] as in *bouhou* [bu'hu] ('taupe') whereas *òu* indicates a diphthongal realisation [ɔw], as in *bòurrou* ['bɔwru] ('âne').

- (iv) All other graphic vowels with grave accents, *ì à ò* in Fébusian orthography indicate tonic stress, e.g., *gnìrgou* ['ɲirgu] ('jargon'); *bilàdyè* [bi'ladye] ('village'); *embòbè* [em'bobe] ('semer').
- (v) In classical orthography, both *a* and *à* are pronounced as [ə] word medially but as [a] in initial position, e.g., *avian* [a'βjən] ('avion'), whereas word-final post-tonic *-a* and *-à* are pronounced [-ɔ], e.g., *bona* ['bunɔ] ('bonne'). Word-final post-tonic [-ɔ] is represented in Fébusian orthography by *-e*, e.g., *boune* ['bunɔ] ('bonne').

In this thesis, I use each of these orthographies with the values attached to them by the militant movements outlined in Section 2.1.4.3: Fébusian orthography for Béarnais; classical orthography for Occitan.

2.2.1.2 TONIC STRESS

In Béarnais, and in most *langue d'oc* varieties more generally, the tonic syllable of lexical words may be final or penultimate. This is not the case in Nissart, whereby tonic stress may be placed on the antepenultimate syllable: proparoxytones in Nissart are equivalent to paroxytones in other *langue d'oc* varieties, e.g., DIES DOMINICA > *diménegue* [di'menege] ('Sunday') in Nissart and *diménye* [di'menje] ('dimanche') in Béarnais. The position of tonic stress on the final or penultimate

syllable is subject to inter-dialectal variation, though the general pattern of tonic stress can be described as follows:

- (i) Stress is lexically defined for any word ending in a vowel other than [a].
- (ii) Words ending in the vowel [a] are always oxytonous, e.g., *cantà* [kan'ta] ('chanter').
- (iii) Words ending in the post-tonic /-ɔ/ are paroxytonous, e.g., *crampe* ['krampɔ] ('chambre'), and lexical stress is not marked in the orthography.
- (iv) Words ending in a consonant are oxytonous, but:
 - verbs in 3rd person plural ending in [-n] are paroxytonous, e.g., *que canten* [ke'kantən] ('ils chantent');
 - verbs in 2nd person singular ending in [-s] are paroxytonous in a majority of tenses, e.g., *que bènes* [ke'benes] ('tu vends');
 - in nouns and adjectives, the plural morpheme [-s] does not modify the stress pattern found in the singular form, e.g., *gouyate* [gu'jatɔ] ('jeune fille') and *gouyates* [gu'jatɔs] ('jeunes filles').

2.2.2 VOWELS

This section includes information on the vocalic systems of Béarnais, Occitan and French discussing oral and nasal vowels separately. The first section traces the evolution of the oral vowel systems from Latin, comparing and contrasting the three varieties. Following on from this, the synchronic oral vowel systems of Béarnais and

Occitan are discussed together followed by that of French. The nasal vowel systems are then presented in the same way, first comparing the varieties historically and then presenting their modern structures.

2.2.2.1 ORAL VOWELS

This section compares the evolution from Latin of the Béarnais, Occitan and French oral vowels with the aim of examining the structural correspondences between their phonologies. The following observations can be made:

- (i) Latin $\bar{I}$ is retained as /i/ in Béarnais, Occitan and French, e.g., $V\bar{I}TAM >$ *bite* ['bitɔ] in Béarnais, *vida* ['biðɔ] in Occitan and 'vie' [vi] in French.
- (ii) Latin $\bar{U}$ became /y/ in Béarnais, Occitan and French in stressed position, e.g., $DURUM >$ *dur* [dyɾ] in Béarnais and Occitan and 'dur' [dyʁ] in French.
- (iii) Latin $\bar{E}$ became /e/ and /ɛ/ in all three varieties, e.g., $BELLUS >$ *bère* ['bɛɾɔ] in Béarnais, *bèla* ['bɛlɔ] in Occitan and 'belle' [bɛl] in French.
The distributions of /e/ and /ɛ/ are different in French when compared with the *langue d'oc* varieties (see Section 2.2.2.1.3).
- (iv) Latin $\bar{A}$ is preserved as [a] in Béarnais and Occitan but became /ɛ/ in French, e.g., $MARE >$ *ma* [ma] in Béarnais, *mar* [ma] in Occitan and 'mer' [mɛʁ] in French.
- (v) Latin –A became word-final post-tonic /-ɔ/ in both Béarnais and Occitan, e.g., $HORA >$ *ore* ['ɔɾɔ] in Béarnais and *ora* ['ɔɾɔ] in Occitan. In modern

SF, the reflex of word-final Latin –A, [ə] or the schwa, is now absent in word-final position, e.g., HORA > ‘heure’ [œːʁ].

(vi) Latin U became /ɔ/ in Béarnais and Occitan, but /u/ in French, e.g., BULLA > *bole* [ˈbɔlɔ] in Béarnais, *bòla* [ˈbɔlɔ] in Occitan but ‘boule’ [bul] in French.

(vii) Latin Ō became /u/ in Béarnais and Occitan, but /œ/ or /ø/ in French, e.g., FLOREM > *hlou* [ˈhlu] in Béarnais, *flor*, [ˈflu] in ‘Occitan and ‘fleur’ [flœːʁ] in French; NEPŌS > *nebout* [neˈbut] in Béarnais, *nebot* [neˈbut] in Occitan, but ‘neveu’ [n(ə)ˈvø] in French.

(viii) Latin O (unstressed) also became /u/ in Béarnais and Occitan but /ɔ/ in French, e.g., PORTŌ > *pourtà* [purˈta] (‘porter’) in Béarnais, *portar* [purˈta] in Occitan, but ‘porter’ [pɔʁte] in French.

2.2.2.1.1 TONIC ORAL VOWELS IN *LANGUE D’OC*

This section presents the tonic oral vowel systems of Béarnais and Occitan together: the phonological inventories of both varieties contain the vowels illustrated in Figures 2.10 and 2.11 (Bouzet, 1928; Bendel, 1934; Grosclaude, 1986; Moreux and Puyau, 2002, 2005; Molyneux 2002)¹⁶.

¹⁶ The points indicated on the vowel quadrilaterals are not intended to imply that vowels are outside the limits of the vowel space but simply to clarify the distinction, in addition to the use of IPA symbols, between rounded and unrounded vowels.

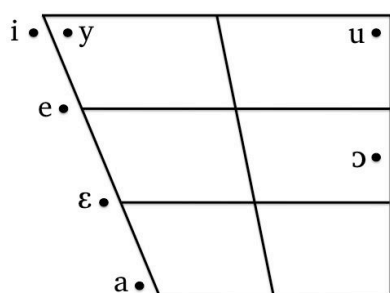


Figure 2.10. The Béarnais Vowel System

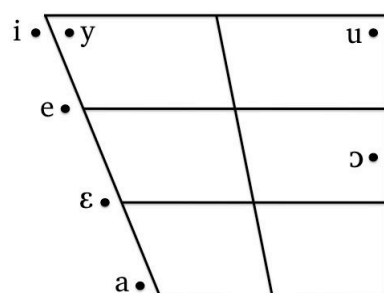


Figure 2.11. The Occitan Vowel System

The Béarnais and Occitan oral vowel systems contain parallel systems of phonemes. The following examples show more clearly the correspondences between the varieties:

Vowel	Béarnais	Occitan
/i/	pic [pik]	picót [pi'kɔt]
/y/	pun [pyn]	punch [pynʃ]
/e/	péch [peʃ]	peis [pes]
/ε/	pè [pε]	pè [pε]
/a/	pa [pa]	par [pa]
/ɔ/	porc [pɔrk]	pòrc [pɔrk]
/u/	poume ['pumɔ]	poma ['pumɔ]

The phonemic contrast between /e/ and /ε/ (< Latin Ē) can be seen in Béarnais in the following examples: *qu'éy* ['kej] ('il est') versus *qu'èy* ['kej] ('j'ai'); *qu'abém*

[ka'βem] ('nous avons') versus *qu'abèm* [ka'βem] ('nous avions'). These contrasts are not present in Occitan where these conjugations would be rendered as: *es* [ɛs] ('il est') and *ai* [aj] ('j'ai'); *avèm* [a'βem] ('nous avons') and *aviam* [a'βjam] ('nous avions').

2.2.2.1.2 PRE- AND POST-TONIC ORAL VOWELS IN *LANGUE D'OC*

The vowel system presented in Section 2.2.2.1.1 above can occur in tonic and atonic syllables. However, in atonic syllables, the contrast between /e/ and /ɛ/ is neutralised and /ɔ/ cannot occur in pre-tonic syllables, where it alternates with /u/, e.g., Béarnais *porc* [pɔrk] ('cochon') and *pourquét* [pur'ket] ('cochonnet').

Only the vowels /i e ɔ/ can occur in post-tonic position in both Béarnais and Occitan: *militàri* [mili'tari] ('militaire') in Béarnais and *militari* [mili'tari] in Occitan; *dise* ['dize] ('dire') in Béarnais and *diser* ['dize] in Occitan; *plouye* ['plujɔ] ('pluie') in Béarnais and *pluèja* ['plɥejɔ] in Occitan.

The realisation of word-final post-tonic /-ɔ/ varies geographically in Béarn and has the following principal phonetic variants [-ɔ -œ -a] as does the realisation of word-final post-tonic /e/ with principal phonetic variants [-e -œ].

For /-ɔ/, the large central area around Pau has historically used the [-ɔ] variant, e.g., *porte* ['pɔrtɔ] ('porte'). In northwestern and north-central Béarn (Orthez, Salies, Sauveterre, Artix, Arthez, Arzacq), the most common variant is [-œ] (Grosclaude, 1986:25; Moreux and Puyau, 2002:28), e.g., *porte* ['pɔrtœ]. Molyneux

describes this northwestern pronunciation as [-œ] but slightly softened (2002:13). While this is ambiguous, Bouzet states that the pronunciation in Orthez and Salies is the same as the final sound in the (presumably southern) pronunciation of the French word ‘utile’ [y'tilə] but even less ‘marquée’ (1928:9), implying that the northwestern variant approximates a weak schwa [-ə], e.g., *porte* ['pɔrtə]. In a very small area of the extreme eastern region of Béarn, particularly in Pontacq and Asson, on the border with the Hautes-Pyrénées *département*, /-ɔ/ is realised as [-a] (Bouzet, 1928:9; Grosclaude, 1986:25; Moreux and Puyau, 2002:28), e.g., *porte* ['pɔrta]. While we have seen that this phoneme is represented word-finally as *-a* or *-á* in classical orthography, in the entire *oc* area, from Bordeaux to Nice, the back open rounded variant [-ɔ] is by far the most common (Grosclaude, 1986:25). The schwa [ə] occurs as a positionally conditioned allophone of post-tonic /ɔ/, in Béarnais, when it occurs before word-final [-s] and [-n] in the second person singular and third person plural conjugations of the *-A* verb class¹⁷, e.g., *que cantes* [ke'kantəs] ('tu chantes'); *que canten* [ke'kantən] ('ils chantent').

For /-e/, [-e] is the majority variant in the central Pau region, e.g., *càdɛ* ['kaðe] ('tomber'). In northwestern and north-central Béarn, /-e/ is realised as [-œ], e.g., *càdɛ* ['kadœ]. Since both /-e/ and /-ɔ/ are realised as [-œ] in these areas, we may note that, in post-tonic word-final position, these phonemes have merged. The

¹⁷ Béarnais contains three verbal groups, ending in *-A*, *-E* and *-I*, e.g., *cantà* ('chanter'), *béne* ('vendre') and *droumi* ('dormir'). The third group, *-I*, is further divided into those verbs that have an *-éch-* [-eʃ-] infix, e.g., *basti* ('bâti') → *que bastéchi* ('je bâtis'), and those which do not, e.g., *droumi* ('dormir') → *que droumi* ('je dors') (Puyau, 2009).

alternative pronunciation of /-e/ as [-œ] is sufficiently widespread in Béarn that it is catered for in Fébusian orthography. In fact, the *Dictionnaire Français-Béarnais* provides double entries, e.g., *càdè* ['kaðe] and *càde* ['kaðœ] (Moreux and Puyau, 2002:145).

2.2.2.1.3 ORAL VOWELS IN STANDARD AND SUPRALocal FRENCH

This section presents the vocalic phonemes of standard and supralocal French focusing primarily on the differences between them. The phonological system of SF is presented in Figure 2.12 below: the high vowels /i y u/; three pairs of mid-vowels /e/-/ɛ/, /ø/-/œ/ and /o/-/ɔ/; one pair of open vowels /a/-/ɑ/; the schwa /ə/.

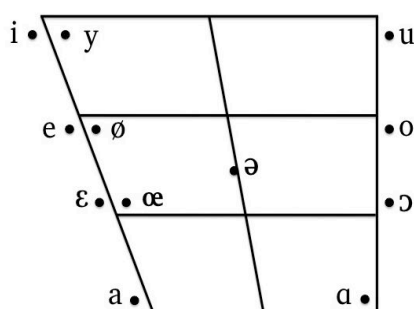


Figure 2.12. The Standard French Vowel System

The mid-vowels of SF are involved in a number of phonemic oppositions as illustrated in the following examples:

[e] ~ [ɛ] *vallée* [e] ~ *valet* [ɛ]

[ø] ~ [œ] *jeûne* [ø] ~ *jeune* [œ]

[o] ~ [ɔ] *hôte* [o] ~ *hotte* [ɔ]

In some contexts, there is evidence for the use of the *loi de position* in SF: open variants occur in closed syllables while close variants occur in open syllables

(Pooley, 2007:47), e.g., ‘gai’ [ge], ‘deux’ [dø] and ‘dos’ [do] with close variants in open syllables; ‘sèche’ [seʃ], ‘seul’ [sœl] and ‘note’ [nɔt] with open variants in closed syllables. The *loi de position* is by no means applied consistently in SF with each mid-vowel pair exhibiting numerous orthographical and phonetically motivated exceptions to this general pattern.

For the /e/ and /ɛ/ mid-vowel pair, [ɛ] always occurs in closed syllables, e.g., ‘fête’ [fet]; ‘serpent’ [sɛʁpɑ̃]. In open syllables, the pronunciation can either be [e] or [ɛ] and this is lexically defined for the most part (see Price, 2005:56-58): [ɛ] generally occurs with the following orthographies in open syllables: *-et, -ais, -ait, -aient, -aix*, e.g., ‘ballet’ [balɛ]; ‘chantait’ [ʃɑ̃tɛ]; [e] is used, for example, with the verbal endings of the future tense whereas [ɛ] is used for the verbal endings of the conditional, e.g., ‘j’irai’ [ʒiʁɛ]; ‘j’irais’ [ʒiʁɛ]. Finally, in non-final syllables the pattern observed follows the *loi de position*: [e] in open syllables and [ɛ] in closed syllables, e.g., ‘détruit’ [detrɥi] and ‘serpent’ [sɛʁpɑ̃].

For the front rounded mid-vowels, /ø/ and /œ/, the number of minimal pairs that exist is limited to only two: ‘veule’ /vøl/ ~ ‘(ils) veulent’ /vœl/; ‘jeûne’ /ʒø̃n/ ~ ‘jeune’ /ʒœ̃n/. In final open syllables, the close-mid vowel is always used, e.g., ‘deux’ [dø], ‘œufs’ [ø]. In final closed syllables, on the other hand, the majority variant is the open-mid vowel, e.g., ‘seul’ [sœl], ‘œuf’ [œf]. In final position, this mid-vowel pair obeys the *loi de position*. The only exception to this is that in final closed syllables ending in /-z/, the vowel employed is lengthened close-mid [ø:],

e.g., ‘heureuse’ [œʁøːz], ‘creuse’ [kʁøːz]. In non-final syllables, the *loi de position* dictates which vowel will be employed, e.g., ‘jeudi’ [ʒødi], ‘meurtrir’ [mœʁtʁiʁ].

For the back mid-vowels, /o/ and /ɔ/, the pronunciation is always [o] in final open syllables, e.g., ‘beau’ [bo], ‘chaud’ [ʃo]. In final closed syllables, on the other hand, both /o/ and /ɔ/ can occur contrastively, e.g., ‘paume’/pom/ ~ ‘pomme’/pɔm/, ‘saute’/sot/ ~ ‘sotte’/sɔt/. There is a tendency for the *loi de position* to apply such that the open-mid variant [ɔ] occurs as the majority variant in final closed syllables, e.g., ‘école’ [ekɔl], ‘note’ [nɔt]. There are, however, numerous orthographical and phonetically motivated exceptions to this pattern. For example, the close-mid vowel [o] is used for graphic *au* in both open and closed syllables, e.g., ‘Pau’ [po] and ‘paume’ [pom], and in syllables closed by [-z], e.g., ‘chose’ [ʃoːz] and ‘rose’ [ʁoːz]. The close-mid variant also occurs in closed syllables when a circumflex accent is present in the orthography, e.g., ‘hôte’ [ot].

The open vowels /a/ and /ɑ/ are traditionally involved in a very small number of phonetic contrasts, e.g., ‘matin’ [matɛ̃] ~ ‘mâtin’ [matɛ̃]; ‘rat’ [ʁa] ~ ‘ras’ [ʁɑ]. The back vowel is markedly less common than the front vowel in SF but when it does occur, it is usually in the following contexts: in monosyllabic words, e.g., ‘là’ [la]; in stressed position before [z] where the vowel is lengthened, e.g., ‘phase’ [fɑːz]; following [w] in monosyllabic words, e.g., ‘fois’ [fwɑ].

The vocalic systems of SF and supralocal French differ primarily in relation to the mid-vowel contrasts, /e/-/ɛ/, /ø/-/œ/ and /o/-/ɔ/, and the open vowel contrast /a/-/ɑ/ in SF. In supralocal French, there is a tendency towards gradual diachronic neutralisation of these phonemic contrasts, though this tendency applies variably to each of the contrasting pairs. In order to make clear the comparison between standard and supralocal French, I have chosen to use the ‘archiphonemic’ symbols, /E œ O A/, for supralocal French, as in Figure 2.13. The high vowels are generally considered to be ‘stable’ in supralocal French (Pooley, 2006:360).

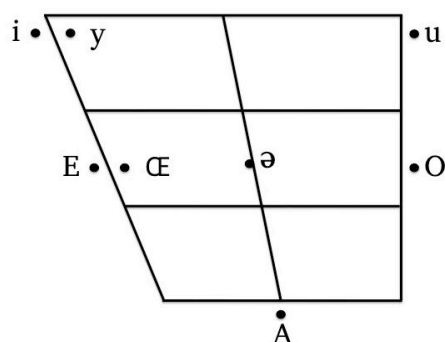


Figure 2.13. The Supralocal French Vowel System

The general supralocal pattern exhibits the following characteristics (Pooley, 2006:360): /a/ and /ɑ/ are pronounced [a] in all positions, e.g., ‘pattes’ [pat] and ‘pâtes’ [pat]; /e/ and /ɛ/ are pronounced [e] in final open syllables, e.g., ‘(je) finirai’ [finiʁe] and ‘(je) finirais’ [finiʁe]; /ø/ and /œ/ are pronounced [œ] in closed syllables, e.g., ‘veule’ [vœl] and ‘veulent’ [vœl]. The /o/-/ɔ/ contrast, however, is said to be maintained in closed syllables, e.g., ‘hotte’ [ɔt] ~ ‘hôte’ [ot], and the majority realisation of the schwa /ə/ vowel is [ø] or [œ] with high rates of deletion in conversational speech. Recent studies of these contrasts in supralocal French have

revealed a significant amount of overlap in the distributions of the mid-vowels and low vowels. Hansen and Juillard (2011) consider these ‘voyelles à double timbre’ and represent the Parisian French vocalic system as having three degrees of vowel height (as in Figure 2.13). Hansen and Juillard’s study compared two corpora of spoken Parisian French: one collected between 1972-1974; one collected between 2001-2004. Their principal findings for vowels occurring in stressed position may be summarised as follows:

- (i) For /E/, between 1972 and 2004, there has been a statistically significant decline in the use of [e] and [ɛ] in open syllables where they are orthographically specified, e.g., [ɛ] for the *-ais*, *-ais*, *-et* orthographies. Intermediate realizations, [ɐ] and [ɛ̃] have become more common for both vowels in all contexts and [ɛ] in particular is being replaced by a raised variant [ɛ̃].
- (ii) For /O/, there has been a statistically significant decline in the use of [o] in stressed open syllables and it is being replaced by intermediate realisations, e.g., ‘trop’ [tʁɔ̃]. In closed syllables, when the phoneme occurs before /ʁ/, there is a tendency to produce intermediate realizations where the *loi de position* would predict [ɔ], e.g., ‘encore’ [ɑ̃kɔ̃ʁ].
- (iii) For /œ/, there is extreme conformity to the prescribed norm in stressed open syllables with 98.6% [ø] in 1972-1974 and 96.8% in 2001-2004, e.g., ‘deux’ [dø]. In closed syllables, particularly when the phoneme

occurs before /ʁ/, there is a tendency to produce intermediate realizations where the *loi de position* would predict [œ], e.g., ‘moteur’ [motœʁ].

- (iv) For /A/, the majority form in the 2001-2004 corpus is the front realization [a] or a centralised variant [ä]. The analysis was not based on syllable structure due to the fact that the *loi de position* traditionally only applies to the mid-vowels. The centralised pronunciation [ä], in the 2001-2004 corpus, is favoured by syllable stress and the presence of /ʁ/ in the syllable coda.

These findings show a number of gradual phonetic mergers in Parisian French. The /a/-/ɑ/ merger is by far the most advanced, followed by /e/-/ɛ/, /ø/-/œ/ and finally, /o/-/ɔ/. The supralocal norm does not, as such, use a strict *loi de position* but the phonetic distinction between the mid-vowel variants is less robust over time. These changes, however, are said to be far from completion and there is a general tendency, for all of the pairs discussed, to favour the close variants of the mid-vowels [e, ø, o] where change-in-progress was identified (Hansen and Juillard, 2011:351).

2.2.2.2 NASAL VOWELS

This section compares and contrasts the evolution of Latin VN (vowel+nasal consonant) sequences in Béarnais, Occitan and French. The following observations can be made:

- (i) Latin IN in closed or late-closed¹⁸ syllables became /i/ in Béarnais, /in/ in Occitan and /ẽ/ in French, e.g., FINUM > *fî* [fi] in Béarnais, *fîn* [fin] in Occitan and ‘fin’ [fẽ] in French. We may note that Old French did have a nasal /i/ vowel (< Latin IN) which subsequently became modern /ẽ/ via a merger with Old French /ẽ/ and /ẽ/. In open syllables, Latin IN became /in/ in Béarnais, /in/ in Occitan and /in/ in French, e.g., FINAM > *fine* [ˈfinɔ] in Béarnais, *fina* [ˈfinɔ] in Occitan and ‘fine’ [fin] in French.
- (ii) Latin EN in closed syllables became /en/ in Béarnais, /en/ in Occitan and /ã/ in French (via Old French /ã/; Rickard, 1974:65), e.g., DENTUM > *dén* [den] in Béarnais, *dent* [den] in Occitan and ‘dent’ [dã] in French. In late-closed syllables, Latin EN became /ẽ/ in Béarnais, /en/ in Occitan and /ẽ/ in French, e.g., PLENUM > *plê* [plẽ] in Béarnais, *plen* [plen] in Occitan and ‘plein’ [plẽ] in French. Finally, in open syllables, Latin EN became /en/ in Béarnais, /en/ in Occitan and /ɛn/ in French, e.g., PLENAM > *plene* [ˈplenɔ] in Béarnais, *plena* [ˈplenɔ] in Occitan and *pleine* [plen] in French.
- (iii) Latin AN in closed syllables became /an/ in Béarnais, /an/ in Occitan and /ã/ in French (via Old French /ã/), e.g., ANNUM > *an* [ãn] in

¹⁸ Late-closed syllables are those which were open in Vulgar Latin but later closed due to the loss of unstressed vowels in final syllables, e.g., SANUM > SAN > *sain* [sẽ].

Béarnais, *an* [an] in Occitan and ‘an’ [ã] in French. In late-closed syllables, Latin AN became /ã/ in Béarnais, /an/ in Occitan and /ɛ̃/ in French, e.g., SANUM > *sâ* [sã] in Béarnais, *san* [san] in Occitan and ‘sain’ [sɛ̃] in French. Latin AN in open syllables became /an/ in Béarnais, /an/ in Occitan and /ɛn/ in French, e.g., SANAM > *sane* [ˈsanɔ] in Béarnais, *sana* [ˈsanɔ] in Occitan and ‘saine’ [sɛn] in French.

- (iv) Latin ON in closed syllables became /un/ in Béarnais, /un/ in Occitan and /ũ/ in French (via Old French /ũ/; Rickard, 1974:65), e.g., PONTEM > *poun* [pũn] in Béarnais, *pont* [pun] in Occitan and ‘pont’ [pɔ̃] in French. In late-closed syllables, Latin ON became /ũ/ in Béarnais, /un/ in Occitan and /ũ/ in French (via Old French /ũ/), e.g., BONUM > *boû* [bũ] in Béarnais, *bon* [bun] in Occitan and ‘bon’ [bɔ̃] in French. Latin ON in open syllables became /un/ in Béarnais, /un/ in Occitan and /ɔn/ in French (via Old French /ũn/), e.g., BONAM > *boune* [ˈbunɔ] in Béarnais, *bona* [ˈbunɔ] in Occitan and ‘bonne’ [bɔn] in French.

- (v) Latin UN in closed and late-closed syllables became /ỹ/ in Béarnais, /yn/ in Occitan and /œ̃/ in French (via Old French /ỹ/), e.g., UNUS > *û* [ỹ] in Béarnais, *un* [yn] in Occitan and ‘un’ [œ̃] in French. There are, however, some instances of Latin UM in late-closed syllables becoming vowel+nasal consonant sequences in *langue d’oc*, e.g., PERFUMUM >

perhum [per'hỹm] in Béarnais, *perfum* [per'fym] in Occitan and 'parfum' [paʁfœ] in French. In open syllables, Latin UN became /ỹ/ in Béarnais, /yn/ in Occitan and /yn/ in French, e.g., UNA > *ûe* [ỹɔ] in Béarnais, *una* ['ynɔ] in Occitan and 'une' [yn] in French.

The historical development of closed and late-closed Latin VN sequences in Béarnais Occitan and French has led to the presence of the following nasal units in each of the varieties, where 'nasal unit' is used here to mean 'any reflex of a historical tautosyllabic VN sequence': Béarnais contains five phonemically nasal vowels /ĩ ỹ ã ü/ and five vowel+nasal consonant sequences /iN yN eN aN uN/; Occitan has five vowel+nasal consonant sequences /iN yN eN aN uN/; French has four phonemically nasal vowels /ẽ œ ã õ/.

The presence of a more complex nasal unit system in Béarnais is a result of the historical deletion of Latin intervocalic –N- in (primarily) late-closed syllables. This development has not taken place in Occitan (or French) (Bendel, 1934:74; Grosclaude, 1986:58), e.g., LUNA > *lûe* [lỹɔ] in Béarnais, *luna* ['lynɔ] in Occitan and 'lune' [lyn] in French; FENESTRA > *hièstre* ['hjɛstrɔ] in Béarnais, *finèstra* [fi'nɛstrɔ] in Occitan and 'fenêtre' [f(ə)nɛtrɛ] in French. This is a prominent feature which distinguishes Béarnais and, other varieties of Gascon, from other *langue d'oc* dialects. The dropping of Latin N resulted in compensatory lengthening and nasalisation of the preceding vowel. Some of these resultant phonemically nasal vowels have subsequently been denasalised in modern Béarnais: /ỹ/ in particular is often completely denasalised to [y], e.g., *û* /ỹ/ [y] ('un') or *ûe* /ỹɔ/ [yɔ] ('une').

2.2.2.2.1 NASAL UNITS IN *LANGUE D'OC*

Béarnais and Occitan nasal units are the synchronic reflexes of Latin closed and late-closed VN sequences. In this section, the synchronic distribution of these nasal units is outlined with particular reference to the phonemic status of Béarnais nasal vowels /ĩ ÿ ẽ ã û/ and vowel+nasal consonant sequences /iN yN eN aN uN/.

Both Béarnais and Occitan have five VN nasal units /iN yN eN aN uN/ though their etymological development has been, as we have seen, somewhat different. In both varieties, the nasal consonant (N) may be [n], [m], [ɲ] or [ŋ]. In Occitan, the vocalic elements are specified by the standard as being fully oral, though coarticulatory nasalisation of the preceding vowel may, of course, occur. In Béarnais, on the other hand, the vowel in each sequence is (variably) nasalised (Séguy and Allières, 1954-1973), e.g., *lɪnyɛ* ['lɪnje] ('linge'); *brun* ['brɥn] ('brun'); *toustém* [tus'tēm] ('toujours'); *crampe* ['krāmpɔ] ('chambre'); *arrounca* [arũŋ'ka] ('ronfler'). For this reason, the Béarnais VN nasal units will henceforth be indicated with a nasal diacritic: /ĩN ÿ̃N ẽ̃N ã̃N û̃N/. The phonemic status of the Béarnais VN nasal units is easily established as they exhibit meaningful contrasts with the oral vowels /i y e a u/: *pintà* /pĩn'ta/ ('pinter') ~ *pità* /pi'ta/; *punte* /'pỹntɔ/ ('pointe') ~ *pute* /'pytɔ/ ('putain'); *crampe* /'krāmpɔ/ ('chambre') ~ *crape* /'krapɔ/ ('chèvre'); *rèndɛ* /'rẽnde/ ('rendre') ~ *réde* /'rede/ ('raide'); *soun* /sũn/ ('ils sont') ~ *sou* /su/ ('soleil').

The Béarnais five-term nasal vowel system /ĩ ÿ̃ ẽ̃ ã̃ û̃/ is illustrated in Figure 2.14. The phonemic status of the nasal vowels is also easily established as they too

are involved in meaningful contrasts with the oral vowels /i y e a u/: *bî* [bî] ('vin') ~ *bi* [bi] ('venir'); *û* [ỹ] ('un') ~ *-u* [y] ('le, lui'); *hê* [hê] ('foin') ~ *hé* [he] ('il fit'); *pâ* [pâ] ('pain') ~ *pa* [pa] ('paire'); *soû* [sũ] ('son') ~ *sou* [su] ('soleil'). In some sub-varieties of Béarnais, these nasal vowels have become completely oral, thus neutralising the contrasts outlined here.

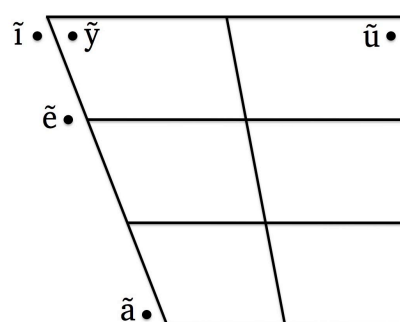


Figure 2.14. Béarnais nasal vowels.

There are no minimal pairs in Béarnais that indicate the nasal vowels and VN nasal units to be in contrastive distribution with each other. Since there is no evidence to suggest that their phonemic identities are different, and given the etymological relationship between the two systems, it seems more useful to consider them as part of one Béarnais nasal unit system which has five phonemic elements /ĩN ỹN ẽN ãN ũN/ which can be further divided into [ĩN ỹN ẽN ãN ũN] (sequential nasal units) and [ĩ ỹ ẽ ã ũ] (non-sequential nasal units). The division of Béarnais nasal units into sequential and non-sequential units also accounts for the lexically-specified distribution of nasal consonants in the nasal units, e.g., *crampe* /'krãNpɔ/ ('chambre') is always realised with a nasal consonant ['krãmpɔ], whereas *câ* ('chien') /kãN/ is not, [kã]; *boû* /bũN/ is never realised with a nasal consonant coda

[bũ], whereas *poun* /pũN/ always has a consonant, [pũn]. As such, [ĩN ỹN ẽN ãN ũN] (sequential nasal units) and [ĩ ỹ ẽ ã ũ] (non-sequential nasal units) may be seen to realise phonologically the same unit while their phonetic structures are, of course, different.

As we have seen that nasalisation is variable in both sequential and non-sequential nasal units, nasal diacritics will always be employed in notation used for the Béarnais nasal units. This is to account for the fact that the phonemic identity of the vowel in any given unit is nasal even if phonetically it may be realised as a denasalised, partially nasalised or fully nasal vowel.

2.2.2.2.2 NASAL VOWELS IN STANDARD AND SUPRALocal FRENCH

The conservative SF phonological inventory has, as we have seen, four nasal vowels /ẽ œ ã õ/ (see Figure 2.15). These nasal vowels also alternate morphologically with a variety of VN sequences (from Latin open syllables). In the front of the vowel space, /ẽ/ and /œ/ are distinguished on the basis of lip-rounding. In the back of the vowel space, /ã/ and /õ/ are distinguished on the basis of vowel height and lip-rounding.

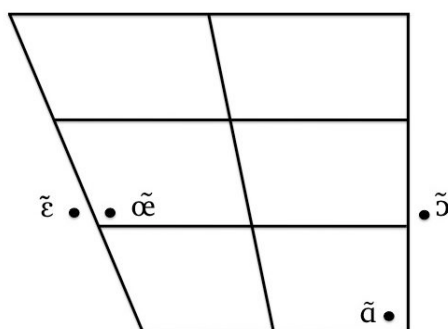


Figure 2.15. Standard French nasal vowels.

The supralocal French nasal vowel system is illustrated in Figure 2.16. In supralocal French, and particularly in Paris, the nasal vowel system has three phonemes / $\tilde{e}$ /, / $\tilde{a}$ / and / $\tilde{o}$ / due to the merger of / $\tilde{e}$ / and / $\tilde{œ}$ / (Pooley, 2006:368). This means that the words ‘parfum’ and ‘un’ above are now pronounced [paʁf $\tilde{e}$] and [$\tilde{e}$], respectively, by a majority of speakers in northern France. There have been some indications of possible mergers between / $\tilde{a}$ / and / $\tilde{o}$ / in supralocal French, where they are only distinguished by lip-rounding of the latter, though this change is said to be a long way from the kind of change that caused the merger of / $\tilde{e}$ / and / $\tilde{œ}$ / (Hansen, 1998).

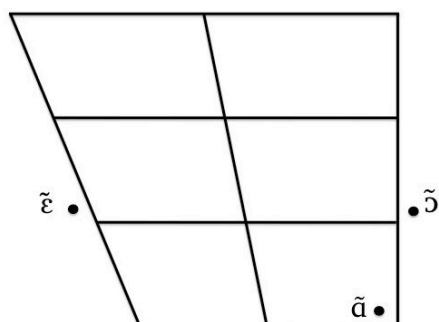


Figure 2.16. Supralocal French nasal vowels.

Additionally, in contemporary Parisian French, Hansen found that nasal vowels appear to be undergoing a counterclockwise chain shift in which front unrounded vowel / $\tilde{e}$ / approaches back unrounded vowel / $\tilde{a}$ /, the back unrounded vowel / $\tilde{a}$ / approaches the back mid-open rounded vowel / $\tilde{o}$ /, and the back mid-open rounded vowel / $\tilde{o}$ / becomes very rounded and close, e.g., ‘bain’→[$\tilde{a}$], ‘banc’→[$\tilde{o}$], ‘bon’→[$\tilde{ø}$] (2001:210).

2.2.3. GLIDES AND DIPHTHONGS

Both SF and standardised Occitan have three glide phonemes /j, w, ɥ/. Béarnais, on the other hand, only has two glide phonemes /j, w/¹⁹ (Bouzet, 1928:9). In Béarnais, /w/ is found in equivalent distributional patterns to /ɥ/ in Occitan, that is to say, /w/ and /ɥ/ have merged in Béarnais, in favour of /w/, e.g., HOC+DIE > *oèy* [wɛj] in Béarnais, but *avueti* [a'βɥɛj] in Occitan.

In SF, the diphthongs of Old and Middle French have been progressively reduced to simple monophthongs (Jones, 2001:28). In French, vowel+glide (or glide+vowel) sequences are traditionally considered as a vowel followed by a glide rather than a diphthong: the glide is considered to be a separate phoneme rather than a component of the syllable nucleus. Accounts of diphthongs in Béarnais and ‘Occitan’, on the other hand, consider vowel+glide (or glide+vowel) sequences to be diphthongs (Bec, 1968:48; Molyneux, 2002:17; Moreux and Puyau, 2005:9). The following combinations are possible in Béarnais (with Occitan and French for comparison):

Latin		Diphthong	Béarnais	Occitan	French
REX	>	/ej/	arréy [a'rej]	rei [rej]	roi [ʁwa]
ECCLESIA	>	/ej/	glèyse [ˈglɛjzɔ]	glèisa [ˈglɛjzɔ]	église [egliːz]
MATER	>	/aj/	may [maj]	maire [ˈmajre]	mère [mɛːʁ]
ESSE	>	/uj/	souy [suj]	soi [suj]	suis [sɥi]

¹⁹ In west-central Béarn and the Pyrenean valleys, and to a lesser extent, the central Pau region, /j/ is replaced by [ɟ] in all positions (word-initially, intervocalically and post-consonantly), e.g., EGO > *you* [ɟu].

GAUDIUM	>	/ɔj/	jòye [ˈʒɔjɔ]	jòia [ˈʒɔjɔ]	joie [ʒwa]
ORIENS	>	/je/	ourientau [urjenˈtaw]	oriental [urjenˈtal]	oriental [ɔʁjɑ̃tal]
FERUS	>	/jɛ/	fiè [fjɛ]	fièr [fjɛ]	fier [fjɛʁ]
BESTIA	>	/ja/	embèstia [embɛˈstja]	embestiar [embeˈstja]	embêter [ãbɛtɛ]
ACTIONEM	>	/ju/	accioû [akˈsjũ]	accion [akˈsjun]	action [aksjɔ̃]
MULUS	>	/jɔ/	miòle [ˈmjɔlə]	muòla [mɥɔlə]	lieu [myl]
SOMNIO	>	/ji/	(que) saunéyi [sawˈneji]	sòmii [ˈsɔmi:]	(je) songe [sɔ̃ʒ]
EUROPA	>	/ew/	Euròpe [ewˈrɔpɔ]	Euròpa [ewˈrɔpɔ]	Europe [øʁɔp]
BREVE	>	/ɛw/	ballèu [baˈlɛw]	lèu [lɛw]	bientôt ²⁰ [bjɛto]
CAUSA	>	/aw/	cause [ˈkawzɔ]	causa [ˈkawzɔ]	chose [ʃoz]
VIVO	>	/iw/	biu [biw]	viure [ˈbiwre]	vit [vi]
PAVOR	>	/ɔw/	pòu [pɔw]	pòu [pɔw]	peur [pœʁ]
OVUM	>	/we/	oéu [wew]	uéu [wew]	oeuf [œf]
WEST ²¹	>	/wɛ/	oèst [wɛst]	oèst [wɛst]	ouest [wɛst]
QUATTUOR	>	/wa/	quoàte [ˈkwate]	quatre [ˈkwatre]	quatre [katʁ]
HLUDWIG ²²	>	/wi/	Louïs [lwis]	Loïs [lwis]	Louis [lwi]
QUAM+DŌ	>	/wɔ/	quoan [kwɔan]	quora [ˈkwɔrɔ]	quand [kɑ̃]

²⁰ Not from Latin BREVE.

²¹ Germanic origin.

²² Germanic origin.

Occitan also has two diphthongs containing the labial-palatal approximant, /ʎε/ and /ʎi/, e.g., FOLIUM > *fuèlha* [ʎʎεʎɔ] (‘feuille’) in Occitan for *hoèlhe* [ʎʎwεʎɔ] in Béarnais; AMBIGUITĀTEM²³ > *ambigüitat* [ambigʎi'tat] (‘ambiguïté’) in ‘Occitan’ for Béarnais *ambigüitat* [ambigwi'tat].

In Béarnais, the diphthongs /aw, ew, εw, ɔw, iw/ also developed from Latin root-final L where it became /w/, forming a diphthong with the preceding vowel (Molyneux, 2002:17), e.g., PALUS > *pau* [paw] (‘pieu’); PILUS > *péu* [pew] (‘poil’); CAELUM > *cèu* [sεw] (‘ciel’); DOLUS > *dòu* [dɔw] (‘deuil’); FILUM > *hiu* [hiw] (‘fil’). In this position, Latin L remained /l/ in ‘Occitan’ and French. This sounds change does however take place in some other *langue d’oc* varieties, namely western Languedocian, Provençal and Limousin.

2.2.4. CONSONANTS

This section presents a comparison of the ‘Occitan’ and Béarnais consonantal systems comparing divergences, both synchronically and from a diachronic perspective with the aim of distinguishing Béarnais from its adjacent *langue d’oc* dialects. Following this, the Béarnais consonantal system is compared to that of SF. This will have the aim of looking for ‘holes in the pattern’ or ‘empty cases’ where the phonemic systems of languages in contact do not correspond and where we might, therefore, expect transfer to occur (Weinreich, 1968:22; see Section 1.1.2).

²³ From Medieval Latin (Oxford English Dictionary Online, www.oed.com).

2.2.4.1 CONSONANTS: BÉARNAIS AND OCCITAN

The consonantal phonemes of Occitan and Béarnais are represented in Figures 2.17 and 2.18 respectively (Bouzet, 1928; Bendel, 1934; Grosclaude, 1986; Moreux and Puyau, 2002, 2005; Molyneux, 2002).

	Bilabial	Labio-dental	Dental/alveolar	Post-alveolar	Palatal	Velar
Stop	p b		t d			k g
Nasal	m		n		ɲ	ŋ
Trill			r			
Tap			ɾ			
Fricative		f	s z			
Affricate				tʃ dʒ		
Approx.					j	
Lateral			l		ʎ	

Figure 2.17. The Consonantal Phonemes of Occitan.

	Bilabial	Labio-dental	Dental/alveolar	Post-alveolar	Palatal	Velar	Glottal
Stop	p b		t d			k g	
Nasal	m		n		ɲ	(ŋ)	
Trill			r				
Tap			ɾ				
Fricative		(f v)	s z	(ʃ ʒ)			h
Affricate					tʃ dʒ		
Approx.					j		
Lateral			l		ʎ		

Figure 2.18. The Consonantal Phonemes of Béarnais.

A comparison of the consonantal systems of Occitan and Béarnais reveals the following points of contrast between them (with French, for reference):

- (i) Latin F became a fully aspirated glottal fricative [h] word-initially before a vowel in Béarnais, while it remains [f] in Occitan²⁴ (Bendel, 1934:43; Grosclaude, 1986:9; Bec, 1986:48; Molyneux, 2002:22) as is illustrated by FARINA, FOCUS and FILIUS:

Latin		Béarnais	Occitan	French
FARINA	>	harie [ha'riɔ]	farina [fa'riɔ]	farine [faʁin]
FOCUS	>	hoèc [hwɛk]	fòc [fɔk]	feu [fø]
FILIUS	>	hilh [hiʎ]	filh [fiʎ]	fil [fis]
FORMATICUM	>	roumàdyɛ [ru'mad̪jɛ]	formatge [fur'mat̪ʝe]	fromage [fʁɔmaʒ]
CALEFACERE	>	cauha [kaw'ha]	calfar [kal'fa]	chauffer [ʃofɛ]

Latin F also changed to [h] before a consonant, particularly before R (Grosclaude, 1986:13). In the case of *roumàdyɛ*, two changes are involved: metathesis of O and R, and the F > [h] change. If metathesis occurred before the F > [h] change, then the sequence is [for] > [fr] > *[hr] > [r], if after, then it is [for] > [hor] > *[hr] > [r]. The pronunciation of [h] is not possible in a cluster with [r] and it weakens to a tapped realisation [ɾ]. In the case of Occitan *formatge*, metathesis did not take place and Latin F is not in a cluster. In this respect, Béarnais is closer to French than Occitan. Finally, Latin F also changed to [h] word-

²⁴ In some northeastern sub-dialects of Béarnais, [h] also developed from Latin S when it occurs syllable finally before another consonant (Moreux and Puyau, 2002:26), e.g., DIS+IEIUNO > *disnà* [dis'na] ('déjeuner') in Béarnais, pronounced [dih'na]. This type of [s] debuccalisation also occurred before the Old French period, but resultant [h] has since been lost, e.g., BESTIAM > 'bête' [bet].

medially in Béarnais, as in CALEFACERE, where it remained [f] in Occitan and in French²⁵.

- (ii) Latin –LL- becomes an apical tap or trill [ɾ ɾ] in Béarnais feminine nouns where it becomes [l] in Occitan and French as illustrated in PULLA and CAPPELLA below (Molyneux, 2002:26). This sound change is again unique to Béarnais (and Gascon more generally). In masculine nouns, Latin –LL- becomes a palatalised affricate [tʃ] when it occurs in coda position as a result of apocope (Grosclaude, 1986:9). In this position, Latin –LL- is root final and possibly ambisyllabic. This sound change, as illustrated in CASTELLUM and CAVALLUS, once again only occurred in Béarnais, among the *langue d’oc* dialects.

Latin		Béarnais	Occitan	French
PULLA	>	poure [ˈpurɔ]	pola [ˈpulɔ]	poule [pul]
CAPPELLA	>	capère [kaˈpɛrɔ]	capèla [kaˈpɛlɔ]	chapelle [ʃapɛl]
CASTELLUM	>	castèth [kasˈtɛtʃ]	castèl [kasˈtɛl]	château [ʃato]
CAVALLUS	>	cabath [kaˈbatʃ]	caval [kaˈbal]	cheval [ʃəval]

Graphic *th* is often called ‘t-mouillé’ and is subject to high levels of interdialectal variation within Béarn (Grosclaude, 1986:9). In north-central Béarn (Arzacq, Arthez, Artix) and northwestern Béarn (Orthez, Sauveterre, Salies), the majority variant is [tʃ], e.g., MARTELLUS >

²⁵ In words borrowed from French and cult words (e.g., *fî* [fi] (‘fin’)), Béarnais often retains the voiceless labiodental fricative even when the loan word has undergone phonological adaptation, e.g., FRAGA > *arrague* [aˈragɔ] (‘fraise’) in Béarnais but *frèse* [ˈfrɛzɔ] < ‘fraise’ [fʁɛz] is also commonly used. Also, the voiced labiodental fricative [v] is present in Béarnais in loan words from French, e.g., *vélo* [veˈlɔ] < ‘vélo’ [velo]; *vaccî* [vakˈsi] < ‘vaccin’ [vaksɛ].

martèth [mar'tet̪ç] ('marteau'). In the Pyrenean region (Ossau, Barétous, Aspe), a post-alveolar affricate [t̪ç] is more common, e.g., *martèth* [mar'tet̪ç]. Elsewhere in Gascony, including central (Pau) and north-central Béarn (Lembeye, Sedzère), the realisation of 't-mouillé' is simply [t], e.g., *martèth* [mar'tet] (Bouzet, 1928:10; Grosclaude, 1986:15, Moreux and Puyau, 2005:8).

- (iii) Béarnais has two palatalised affricate phonemes: voiceless /t̪ç/ (< Latin –LL–) and voiced /d̪ç/ while Occitan has two post-alveolar affricate phonemes: /t̪ʃ/ and /d̪ʃ/. Latin –TC– sequences, that occurred as result of elision, such as VILLATICUM < VILLA, developed into [d̪ç] in Béarnais and [t̪ʃ] in Occitan, e.g., VILLATICUM > *bilàdyə* [bi'lad̪çə] ('village') in Béarnais and *vilatge* [bi'lat̪ʃe] in Occitan; VIATICUM > *biàdyə* ['bjad̪çə] ('voyage') in Béarnais and *viatge* ['bjat̪ʃe] in Occitan. Occitan /d̪ʃ/ developed from Latin IU–, for example, IUVENIS > JOVENIS > *jove* ['d̪ʃuβe] ('jeune') in Occitan. The equivalent phoneme in Béarnais is /j/, e.g., IUVENIS > JOVENIS > *yoén* [jwen] ('jeune'). The Occitan affricates /t̪ʃ/ and /d̪ʃ/ may also be depalatalised to [ts] and [dz], respectively, e.g., *vilatge* [bi'lat̪se] ('village') and *jove* ['d̪zuβe] ('jeune').

- (iv) Latin –MB- and –ND- sequences became [m] and [n] respectively in Béarnais while they remained [mb] and [nd] in the rest of the *langue d’oc* dialects (Bec, 1963:48). The [b] and [d] phones were also retained in French, though the vowel+nasal consonant sequences have been replaced by fully nasalised vowel, as illustrated by the examples below.

Latin		Béarnais	Occitan	French
CUMBA	>	coume [ˈkumɔ]	comba [ˈkumbɔ]	combe [kɔ̃b]
DECEMBER	>	decéme [deˈseme]	detembre [deˈsembre]	décembre [desãbɛ]
RETUNDA	>	ardoune [arˈdunɔ]	ronda [rundɔ]	ronde [rɔ̃d]
TUNDERE	>	toune [ˈtune]	tondre [ˈtundre]	tondre [tɔ̃dɛ]

- (v) Before Latin R- in word-initial position, Béarnais inserts a prosthetic prefix [ar-], which does not occur in Occitan or French, as illustrated by the examples below. This is hypothesised to be due to contact between Vulgar Latin and the Aquitain (Basque) substrate. For example, the word for ‘king’ is *arréy* [aˈrej] (‘roi’) in Béarnais and *errege* [ereye] in Basque.

Latin		Béarnais	Occitan	French
REGEM	>	arréy [aˈrej]	rei [rej]	roi [ʁwa]
RICA	>	arrèc [aˈrek]	rèc [rek]	ruisseau ²⁶ [ʁɥiso]
RIPARIA	>	arribère [ariˈbɛrɔ]	rivièra [riˈbjɛrɔ]	rivière [ʁivjɛːʁ]
ROTA	>	arrode [aˈrɔdɔ]	ròda [ˈrɔdɔ]	roue [ʁu]

²⁶ RIVUS > RIVUSCELLUS > ‘ruisseau’ [ʁɥiso].

- (vi) Metathesis occurs in Béarnais where Latin root-final R moves to the onset of the word-initial syllable, forming a consonant cluster. This happened both when R occurred in a root-final cluster, as in FEBRIM and CAPRA, and where it occurred intervocalically, as in the examples COMPARARE and PAUPEREM. Metathesis did not take place in Occitan or French in this context.

Latin		Béarnais	Occitan	French
FEBRIM	>	frèbe [ˈfrɛβe]	fèbre [ˈfɛβre]	fièvre [fjɛ:vʁ]
CAPRA	>	crape [ˈkrapɔ]	cabre [ˈkaβrɔ]	chèvre [ʃɛ:vʁ]
COMPARARE	>	croumpa [kɾumˈpa]	comprar [kumˈpra]	acheter ²⁷ [aʃɛte]
PAUPEREM	>	praube [ˈpɾawβe]	paure [ˈpawre]	pauvre [po:vʁ]

- (vii) Latin word-final –S often becomes [j] in Béarnais but not in Occitan (Grosclaude, 1986:63). The S > [j] change affects mainly three frequent lexical items, as illustrated by the examples below.

Latin		Béarnais	Occitan	French
IAM + MAGIS	>	yaméy [jaˈmej]	jamés [dʒaˈmes]	jamais [ʒamɛ]
MAGIS	>	méy [mej]	mes [mes]	mais [mɛ]
EST	>	qu'éy [kej]	es [es]	est [ɛ]

This sound change exhibits considerable geographical variation in Béarn.

In western Béarn, the diphthongal realisations are replaced by

²⁷ AD+CAPTARE > ACCAPTARE > ‘acheter’ [aʃɛte].

monophthongs (Moreux and Puyau, 2005), e.g., *yaméy* [ʒa'me]²⁸, *méy* [me], *qu'éy* [ke]. The most southern part of Béarn, notably the Pyrenean valleys, have retained the [s] of the Latin root, e.g., *yaméy* [ʒa'mes]²⁹, *méy* [mes], *qu'éy* [kes].

- (viii) Latin root-final R often drops when it occurs in a consonant cluster with an occlusive, particularly after [t], and followed by a word-final post-tonic vowel. This R-dropping does not take place in Occitan or any other *langue d'oc* dialects (Grosclaude, 1986).

Latin		Béarnais	Occitan	French ³⁰
NOSTRUM	>	noùstɛ [ˈnuste]	nòstre [ˈnɔstre]	notre [nɔtrɛ]
ALTER	>	àutɛ [ˈawte]	autre [ˈawtre]	autre [otrɛ]
MAGISTER	>	mèstɛ [ˈmeste]	mèstre [ˈmestre]	maître [mɛtrɛ]
ARBOR	>	àrbɛ [ˈarβe]	arbre [ˈarbre]	arbre [aʁbʁɛ]

- (ix) There is considerable geographical variation in alternations between voiced and voiceless obstruent pairs, [p b], [t d], [k g] when they form consonant clusters with nasal consonants [m] and [n] (Moreux and Puyau, 2002:25; Molyneux, 2002:21-29). The Fébusian orthographical system allows both variants to be represented orthographically depending

²⁸ Note also the western variant of the /j/ phoneme, [ʒ].

²⁹ Note also the Pyrenean variant of the /j/ phoneme, [ʒ].

³⁰ In some urban varieties of northern supralocal French of post-obstruent liquid dropping is common (Boughton, 2005:249), e.g., ‘notre’ [nɔt], ‘autre’ [ot] etc. This differs from Béarnais however because there is no final vowel in the French case.

on localised pronunciations. Standardised Occitan, however, retains the more conservative pronunciation vis-à-vis Latin, as illustrated below.

Latin	Béarnais 1	Béarnais 2	Occitan	French
CAMERA	> crampe [ˈkrampɔ]	crambe [ˈkrambɔ]	cambra [ˈkambrɔ]	chambre [ʃɑ̃brɛ]
CANTARE	> canta [kanˈta]	canda [kanˈda]	cantar [kanˈta]	chanter [ʃɑ̃te]
SANGUIS	> sanc [ˈsɑ̃ŋk]	sang [ˈsɑ̃ŋg]	sang [ˈsɑ̃ŋg]	sang [sɑ̃]

In some Pyrenean sub-dialects, intervocalic /b d g/ are replaced by their corresponding voiceless consonants /p t k/ when they occur before [a ɔ y u]:

Latin	Béarnais	Pyrenean	Occitan	French
CAPRA	> crabe [ˈkraβɔ]	crape [ˈkrapɔ]	cabre [ˈkaβrɔ]	chèvre [ʃɛ:vʁ]
AMARE	> aymade [ajˈmaðɔ]	aymate [ajˈmatɔ]	aimada [ajˈmaðɔ]	aimée [eme]
FORMICA	> arroumigue [aruˈmiɣɔ]	arroumique [aruˈmikɔ]	formiga [furˈmiɣɔ]	fourmi [fuʁmi]

In both Occitan and Béarnais, the voiced plosives /b d g/ have contextually conditioned allophonic variants [β ð ɣ] when they occur intervocalically or intervocalically in a consonant cluster with [r l z]³¹, as illustrated in the examples above.

³¹ In northeastern Béarn, in the *Vic Bilh* region, Latin intervocalic –D– is realised as [z] (Moreux and Puyau, 2002:25, 2005:10; Molyneux, 2002:27), e.g., PEDICULUS > *pedoulh* [peˈðuɫ] (‘pou’) in Béarnais is pronounced locally as [peˈzuɫ]. In the same sub-dialect, for Latin intervocalic –B–, lenition is further advanced and [β] is realised as [w]: BIBERE > *bébe* [ˈbeβe] (‘boire’) in Béarnais and is pronounced locally as [ˈbewe].

2.2.4.2 CONSONANTS: BÉARNAIS AND FRENCH

The consonantal phonemes of SF are presented in Figure 2.19. This section compares the consonantal systems of Béarnais and French in order to identify the points at which they diverge. An inspection of the consonantal inventories reveals the following points of contrast (see Figure 2.18 for Béarnais):

	Bilabial	Labio-dental	Dental/alveolar	Palato-alveolar	Palatal	Velar	Uvular
Stop	p b		t d			k g	
Nasal	m		n		ɲ	ŋ	
Fricative		f v	s z	ʃ ʒ			ʁ
Lateral			l				

Figure 2.19. The Consonantal Phonemes of French (from Jones, 2001:29).

- (i) SF does not have a /h/ phoneme. This is because French retains Latin F as [f] while this evolved to [h] in Béarnais, e.g., FUMARE > *huma* [hy'ma] in Béarnais and ‘fumer’ [fume] in French.
- (ii) Both French and Béarnais have a /b/ phoneme but French /b/ derives from Latin B while Béarnais /b/ derives from both Latin B and Latin V e.g., BELLA > *bère* ['bɛrɔ] in Béarnais and ‘belle’ [bɛl] in French; VIDERE > *béde* ['beðe] in Béarnais but ‘voir’ [vwɑʁ] in French. Thus, Latin B and V have merged to a single phoneme, /b/, in Béarnais and, as we have seen, Béarnais only uses [v] in some loan words of French origin (Molyneux, 2002:21; Bouzet, 1928:10), e.g., *televisoû* [televizũ] < ‘télévision’ [televizjɔ̃].

- (iii) The velar nasal [ŋ] entered French during the twentieth century in a small number of borrowings from English (Jones, 2001:30), such as ‘le parking’ [lə pɑʁkiŋ] for ‘parc de stationnement’, and is now considered a phoneme of the language. The velar nasal occurs in Béarnais in borrowings from English via French, e.g., *lou parquing* [lu par'kiŋ] (‘le parking’). The phonemic status of /ŋ/ in Béarnais is debatable but [ŋ] regularly occurs as an allophone of /n/ before the velar plosives [k] and [g], e.g., *sanc* [saŋk] (‘sang’); *engoère* [eŋ'gwɛrɔ] (‘encore’).
- (iv) SF /ʁ/ is a voiced uvular fricative [ʁ]³². In Béarnais, the apical trill /r/ and apical tap /ɾ/ phonemes are involved in some phonemic contrasts, e.g., *pourét* [pu'ret] (‘poulet’) ~ *pourrét* [pu'ret] (‘poireau’). The distribution of [r] and [ɾ] is somewhat constrained by their position within the syllable and with respect to word boundaries with a tendency for [r] to occur word-initially and as an onset after [n], and [ɾ] to occur in onset clusters and in the syllable coda, but this distribution is by no means categorical (Cardaillac 1973:32). Additionally, Béarnais rhotics are sometimes replaced by a uvular realisation [ʁ] which constitutes interference or transfer from French due to language contact³³.

³² There is evidence to suggest that in modern-day supralocal speech, /ʁ/ is being realised increasing as a voiced uvular approximant [ʁ̥] (Coveney, 2001:57), particularly in final position (Fougeron and Smith, 1999:80).

³³ French had both the [r] and [ɾ] sounds until the eighteenth century but by the time of the Revolution, in Paris at least, they had largely been replaced by the uvular fricative [ʁ] (Rickard, 1974:108).

- (v) The phonological inventory of Béarnais (and Occitan) contains the voiced palatal lateral approximant /ʎ/ which is not present in French. This phoneme is generally represented in the orthography by *lh*, e.g., LECTUS > *lhéyt* [ʎejt] ('lait' [lɛ]); PALEA > *palhe* ['paʎɔ] ('paille' [paj]); TRIPALIUM > *tribalh* [tri'βaʎ] ('travail' [tʁavaj]). Historically, French had /ʎ/ in words like 'paille', 'bouteille' 'grenouille' etc. but it was replaced by /j/ by the middle of the nineteenth century (Rickard, 1974:126). Correspondences between Béarnais /ʎ/ and French /j/ can be seen in the following examples using the feminine Latin –ULA suffix: VETULA > *biélhe* ['bjeʎɔ] ('vielle' [vjɛj]); APICULA > *abélhe* [a'βeʎɔ] ('abeille' [abɛj]); RANUNCULA > *graulhe* ['grawʎɔ] ('grenouille' [gʁənɥj]).
- (vi) SF has no affricates that have developed from Latin and when they do occur, as [tʃ] and [dʒ], they are borrowings (Jones, 2001:30), e.g., 'Tchèque' [tʃɛk] < 'Czech' [tʃɛk] in English; 'gin' [dʒin] < 'gin' [dʒin] in English. While these affricates do occur as variants of /tʃ/ and /dʒ/ in some sub-dialects of Béarnais, they are not phonemic. Béarnais /tʃ/ corresponds to /l/ in French (< Latin root-final –LL–) in words such as 'cheval' [ʃəval] or words such as 'chapeau' [ʃapo] or 'chateau' [ʃato] (formerly, 'chapel' [ʃapɛl] and 'chastel' [ʃastɛl]) that owe their present form to back-formations from their plural forms during the Middle French

period (Rickard, 1974:68). Béarnais / $\widehat{d\dot{j}}$ /, on the other hand, corresponds to French / ʒ /: MATRIMONIUM > *maridàdyɛ* [mari'ðad $\widehat{j}$ ɛ] ('mariage' [maʁia: ʒ]); VILLATICUM > *bilàdyɛ* [bi'lad $\widehat{j}$ ɛ] ('village' [vila: ʒ]).

2.3 REGIONAL FRENCH PHONOLOGY

It is assumed that contact between French and the local languages and dialects of France has led to the emergence of contemporary regional varieties of French. In Béarn, RF appears to have emerged from contact between French and the local variety of *langue d'oc* spoken in the region, Béarnais. This section provides a description of the distinctive phonological and phonetic features of southern RF with specific emphasis on the varieties spoken in Gascony and Béarn.

2.3.1 SOUTHERN REGIONAL FRENCH

Armstrong and Blanchet note that, while in northern France, dialectal forms have become social markers of lower class, middle class and rural social groups, southern RF forms have remained regional markers shared by all social groups (2006:258). The varieties of RF spoken in the southern third of France share noticeable similarities, mainly in pronunciation, although people from the different regions are said to be able to identify the differences between them (Armstrong and Blanchet, 2006:264). This section examines features that are common to the varieties of RF spoken across the south of France, focusing on (largely qualitative) studies detailing the phonological systems present in the early and late twentieth century.

Despite being outdated, Martinet's (1945) study provides some information on the nature of southern RF in the early twentieth century, albeit based on self-

reported data from a small sample of relatively socially homogeneous male subjects. Martinet divides the south of France into two main areas: the Midi and the southwest sub-region (Gironde, Dordogne, Corrèze) (12 informants). The reason for this subdivision is that there are often ‘des caractéristiques plus septentrionales que méridionales’ (1945:29-30) in the data. More recent studies such as Walter (1982) and Carton et al. (1983) offer a greater number of regional subdivisions for southern varieties of French and all of Walter’s informants were born into local families and spoke the autochthonous language appropriate to their area. Again, however, the sample sizes were limited. These data sets will, however, provide a reference point against which to examine the modern-day variation in RF.

2.3.1.1 ORAL VOWELS

The oral vowels of southern RF in final open syllables and final closed/non-final syllables, as reported by Martinet (1945), are presented in Figures 2.20 and 2.21 respectively. These distributions are taken to be indicative of the southern oral vowel systems in the first half of the twentieth century (Pooley, 2007:43). Armstrong and Pooley refer to these systems as forming part of the Dominant Southern Pattern (DSP): the phonological features common to the varieties of French used throughout the south of France and widely referred to by non-specialists as the *accent du Midi* or the *accent du Sud*, in contrast with the terms *français méridional* and *français d’oc*, used only by specialists (2010:188).

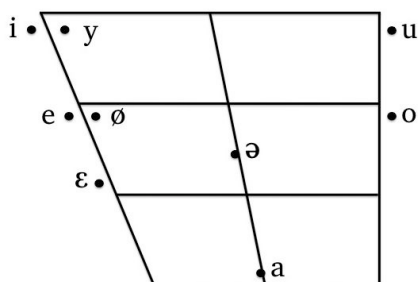


Figure 2.20. Southern French: Oral vowels in final open syllables (following Martinet, 1945)

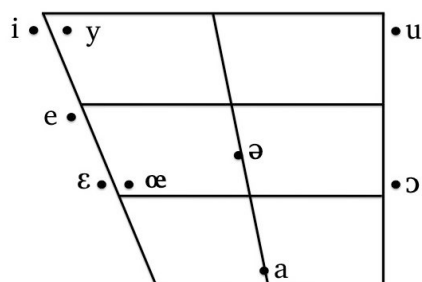


Figure 2.21. Southern French: Oral vowels in final closed and non-final syllables (following Martinet, 1945)

The high vowels /i y u/ occur in all syllable types and this pattern parallels those presented above for the standard and supralocal norms. In the front of the vowel space, /e/ and /ɛ/ can occur in all syllables types, indicating the maintenance of standard contrasts. For the front rounded mid-vowels, on the other hand, the DSP follows the *loi de position* with [ø] in final open syllables and [œ] in closed and non-final syllables. This implies the neutralisation of contrasts present in the standard, e.g., ‘veule’ /vøl/ and ‘veulent’ /vœl/ both pronounced as [vœl]. The back mid-vowels also follow the *loi de position*, with close-mid [o] in open syllables and open-mid [ɔ] in closed syllables. Again, this implies the neutralisation of SF contrasts, e.g., ‘saute’ /sot/ and ‘sotte’ /sɔt/ both pronounced as [sɔt], and the regularisation of (standard) ‘exceptions’ in specified phonetic contexts, e.g., ‘chose’ /ʃoz/ and ‘rose’ /ʁoz/ pronounced as [ʃɔːz] and [ʁɔːz] respectively. The /a/-/ɑ/ contrast of SF is not used by Martinet’s southern informants, with a centralised [a] used in all positions, e.g., SF ‘patte’ /pat/ and ‘pâte’ /pat/ both pronounced as [pät]. Based on this information, we can conclude that DSP in the first half of the twentieth century

(at least for Martinet's informants) contains the following oral vowel phonemes: /i y u e ε œ O A/ and the schwa /ə/ (see Section 2.3.1.2). The 'archiphonemic' symbols /œ O A/ are used here to indicate a neutralisation of phonemic contrasts present in SF. For /O/, of course, allophonic variants conditioned by the *loi de position* are present in the DSP.

Figures 2.22 and 2.23 present the southern oral vowel distributions reported in Walter (1982) and Carton et al. (1983) for final open syllables and final closed syllables, respectively. This data shows that the high vowels /i y u/ remain stable between 1945 and the 1980s. For the low vowels, /a/ and /ɑ/, the standard contrast is neutralised to [a], as was the case for Martinet's informants. Pooley notes, however, that the quality of this merged category varies geographically in final open position: intermediate realisations (between [a] and [ɑ]) are found, particularly for short vowels, e.g., 'là' [lə]; occasional raising and backing to [ɔ] was also found in Provence (2007:47).

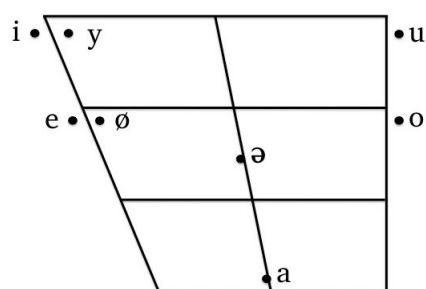


Figure 2.22. Southern French: Oral vowels in final open syllables (following Walter, 1982; Carton et al., 1983).

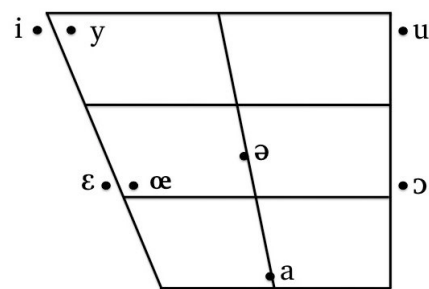


Figure 2.23. Southern French: Oral vowels in final closed syllables (following Walter, 1982; Carton et al., 1983).

The picture that emerges of the mid-vowels is that the DSP in the latter half of the twentieth century has majority variants which follow the *loi de position* with close variants [e ø o] occurring in open syllables and open variants [ɛ œ ɔ] occurring in closed syllables. This differs from Martinet's (1945) data in that the /e/-/ɛ/ contrast of SF is neutralised, as well as the standard contrasts between /ø/ and /œ/ and between /o/ and /ɔ/. Walter and Carton et al.'s studies diverge slightly regarding the variants noted in open and closed syllables for the mid-vowels. In Walter's data, the large majority of informants strictly follow the *loi de position* (as indicated in Figures 2.22 and 2.23 above). For Carton et al.'s informants, on the other hand, there are some speakers who use either [o] or [ɔ] in both open and closed syllable types.

The most problematic contexts for analysing the mid-vowel contrasts in southern RF are what Taylor (1996) calls 'pseudo-closed' syllables, tonic syllables that would be closed in SF, e.g., 'neige' [nɛʒ], but where the mid-vowel is followed in southern RF by a syllable whose nucleus is the schwa, leaving the tonic syllable open, e.g., 'neige' [nɛ.ʒə] or [ne.ʒə]. Taylor (1996) claims that, in the French of Aix-en-Provence, mid-vowels in these contexts are variable: the presence of schwa does not categorically cause the mid-vowel to behave as if it were in an open syllable. There is evidence to suggest, however, that mid-vowels in pseudo-closed syllables may behave as if they are the nucleus of a closed syllable (Armstrong and Pooley, 2010:198), e.g., 'neige' [nɛ.ʒə].

Based on the information in Figures 2.22 and 2.23, we can conclude that the DSP in the 1980s had the following phonological inventory: /i y u E œ O A/ and the schwa /ə/ (see Section 2.3.1.2).

Both Walter (1982) and Carton et al. (1983) include informants from Gascony. Figures 2.24 and 2.25 represent their phonological vowel spaces in open and closed syllables, respectively. As with the DSP, there is no difference in the distribution of the high vowels from standard or supralocal French. There is however, considerable variation noted for Gascony informants regarding the low vowels and particularly regarding the distribution of the mid-vowels.

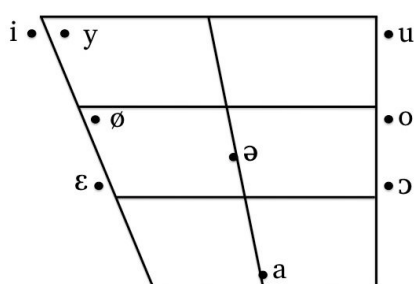


Figure 2.24. Gascony French: Oral vowels in final open syllables (following Walter, 1982; Carton et al., 1983).

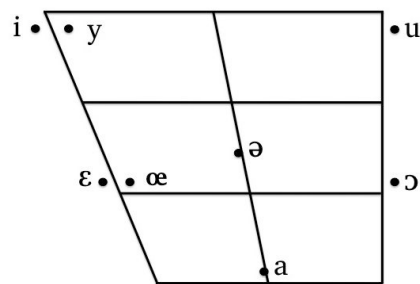


Figure 2.25. Gascony French: Oral vowels in final closed syllables (following Walter, 1982; Carton et al., 1983).

Both studies confirm that there is no /a/-/ɑ/ contrast in the RF of Gascony. Walter does note, however, that the neutralisation of this front-back contrast has given rise to centralised variants, e.g., ‘pas’ [pă] for SF [pa]. This is a characteristic shared with the DSP and northern supralocal French. For the front unrounded mid-vowels, both studies show that there is no /e/-/ɛ/ contrast. In this case there is marked divergence from the late twentieth century DSP, with no *loi de position*: [ɛ] is the majority variant in both open and closed syllables. Thus, for example, SF ‘je ferai’

/e/ and ‘je ferais’ /ɛ/ are both pronounced with [ɛ], as is the vowel of ‘sept’ /set/ [sɛt]. The merger of /e/-/ɛ/ to /ɛ/ is also distinct from supralocal French in that both vowels are merged into one (open) vowel rather than exhibiting high levels of variability between the two, with certain contextual tendencies (cf. Hansen and Juillard, 2011).

In Walter’s study, the front rounded vowels are not contrasted and their pronunciation conforms to the *loi de position* with [ø] in open syllables and [œ] in closed syllables, a pattern which parallels that of the DSP. Carton et al. note only the occurrence of [œ] in open syllables, e.g., ‘deux’ /dø/ [dœ], contradicting Walter, and provide no equivalent for closed syllables (1983:61).

Carton et al.’s informants do not have an /o/-/ɔ/ contrast in closed syllables and do not use the *loi de position*, with [ɔ] occurring in all contexts, e.g., SF ‘paume’ /pom/ and ‘pomme’ /pɔm/ are both pronounced as [pɔm]; SF ‘boulot’ /bulo/ > [bulɔ]. Carton et al. note, however, that this merged [ɔ] variant is not as open as the /ɔ/ of SF but somewhere in between [o] and [ɔ] (1983:61), e.g., ‘époque’ /epɔk/ realised as [ɛpɔkə]; ‘vélo’ /velo/ realised as [vɛlɔ]. The inclusion of [o] in Figure 2.24 is based on Walter’s informants who, unlike those of Carton et al., use the *loi de position* consistently with [o] in open syllables and [ɔ] in closed syllables.

From the Gascony informants in Walter and Carton et al.’s studies, we can deduce two possible southwestern phonological systems for the oral vowels: Walter’s informants have a system containing /i y u ɛ œ O A/ and the schwa /ə/; Carton et al.’s informants use a system containing /i y u ɛ œ ɔ A/ and the schwa /ə/.

Both southwestern RF systems diverge from the DSP (/i y u E œ O A/ and the schwa /ə/).

Finally, Moreux (1985a; 1985b; 2006) focused on the *loi de position* and the maintenance of SF mid-vowel contrasts in Béarn (and Bigorre). Reading passage data was collected in the early 1980s from sixty-one informants native to the region and stratified by age (> 65 years, 25-65 years, < 25 years). Moreux notes an increase in the use of the *loi de position* in younger generations and particularly for those younger informants who had migrated from rural to urban areas within the region (2006:310). For some of the informants in the oldest generation, the /e/-/ɛ/ contrast was realised in final open syllables, e.g., ‘j’irai’ [e] ~ ‘j’irais’ [ɛ]. The vast majority of speakers in the two younger generations, however, tended to use the *loi de position* in this context and thus to neutralise the phonemic opposition, e.g., ‘j’irai’ [e] ~ ‘j’irais’ [e]. In non-final syllables, the pattern tended towards the *loi de position* for speakers of all ages. In final closed syllables, [ɛ] was used consistently by all speakers. For the front rounded vowels, /ø/ and /œ/, Moreux observed 37% conformity to the *loi de position* in open syllables when all speakers were considered together: the majority of speakers used [œ] in this context, e.g., ‘heureux’ /øʁø/ [œrø]. Moreux notes, however, that most young speakers, particularly those who had moved away from rural areas, respected the *loi de position* completely for the front rounded vowels in all positions. For the back mid-vowels, some speakers in the older and middle generations used [ɔ] in all positions, e.g., ‘auto’ /oto/ [ɔtɔ], thus neutralising the standard /o/-/ɔ/ contrast, whereas some used intermediate variants,

between [o] and [ɔ] in all positions (cf. Carton et al., 1983). These intermediate variants were absent in the speech of the younger generations who used both [o] and [ɔ] variants in conformity with the *loi de position*. Moreux's findings in Béarn indicate then that, while older speakers do not consistently conform to the *loi de position*, there was a general tendency among younger speakers towards positional conditioning of the mid-vowels in line with the DSP pattern.

2.3.1.2 SCHWA RETENTION

Martinet's (1945) southern informants reported that they retained schwa in word-final and word-medial position as well as in monosyllables. Epenthetic schwa in collocations where schwa is not represented orthographically, e.g., ours[ə] blanc, was less used by southerners than by people from other parts of France (Pooley, 2007:42). Walter's (1982) southern informants show considerable variability, although schwa retention in all positions is the clear majority variant in her data. Carton et al.'s (1983) informants manifest high rates of schwa retention in all regions (Gascony, Languedoc and Provence) word-finally, word-medially and in frequent monosyllabic words, e.g., 'place' [plasə], 'seulement' [sələmə], 'me' [mə]. Pooley notes, however, that although schwa retention has been analysed in a large number of sites in southern France, few studies have sought to examine the possible sub-regional differences in its phonetic realisation. Schwa retention in all contexts appears, from the data discussed here, to be the majority variant in the DSP in both the early and the late twentieth century.

Brun (1931) noted, in the first half of the twentieth century, that there was considerable geographically-based phonetic variation in the realisation of schwa

within the southwestern region (although there is little empirical evidence available to back up this claim): [ə] occurred word-medially and [œ] occurred word-finally and in frequent monosyllabic words. In the Gers, Walter (1982) cites the following percentage realisations of schwa: word-final (66%) and word-medial (100%). She also notes that, in Gascony, schwa is realised as close-mid rounded [ø] word-finally in frequency monosyllabic words, e.g., ‘me’ [mø]. Walter cites examples such as ‘bois-le’ [bwa'lø], although given that the schwa occurs in stressed position in this context, it would also be realised this way in the standard. Carton et al. state that in Gascony, the schwa is retained as the majority variant in the following contexts (1983:61): word-finally before a consonant, word-finally before a vowel, pre-pausally, and word-medially, e.g., ‘cette commission’ [setəkəmisjõ], ‘entre Ossun’ [ãtrəɔsœ], ‘la plaine’ [laplənə], ‘éperon’ [epəɾõ]. The evidence presented here thus implies that schwa retention in Gascony reflects the general DSP pattern: schwa is retained at high frequencies in all positions.

2.3.1.3 NASAL VOWELS

Southern varieties of RF traditionally have four contrastive nasal vowel phonemes, /ɛ̃ œ̃ ā̃ ɔ̃/, with at least three variable parameters: vowel quality; nasalisation (nasalised, partially nasalised, denasalised); nasal consonant coda presence/absence. Taylor (1996) uses the term ‘nasal unit’ to capture the variable presence of a nasal consonant in what is a single phonological entity, e.g., ‘chambre’ /ʃābrə/ > [ʃāmbɾə] or [ʃābrə]. The term ‘nasal unit’ was used in Section 2.2.2.2, in relation to Béarnais, Occitan and French, to mean ‘any reflex of a historical tautosyllabic VN

sequence’. For the purposes of this discussion, this also fits within Taylor’s definition of a ‘nasal unit’. While a distinction was made, in Béarnais, between lexically defined sequential [ṽN] and non-sequential [ṽ] nasal units, the presence or absence of a nasal consonant in French is not lexically specified, it is variable. Thus, in southern RF, both sequential and non-sequential *phonetic* nasal units can represent the *phonological* ‘nasal vowel’, as in the ‘[fãmbɾə] or [fãbrə]’ example noted above.

In Martinet’s (1945) data, southern informants were shown to use a four-term nasal vowel system with the /ẽ/-/œ̃/ contrast reported by 98% of speakers. Marked regional accents were characterised by denasalised vowels followed by nasal consonant codas, e.g., ‘simple’ /sẽpl/ [sempl(ə)], ‘brun’ /bʁœ̃/ [broɛŋ], ‘bouton’ /butõ/ [butɔŋ], ‘déranger’ /dɛʁãʒe/ [deranzɛ]. The nasal consonant codas used in sequential units exhibited place-of-articulation assimilation with the following oral consonant: [n] before /t/, /d/, /s/, /z/, /ʃ/ and /ʒ/, e.g., ‘chanter’ /ʃãte/ [ʃante]; [m] before /p/ and /b/, e.g., ‘plombier’ /plõbje/ [plɔmbje]; [ŋ] before /k/ and /g/, e.g., ‘manquer’ /mãke/ [maŋke]; [ŋ] pre-pausally, e.g., ‘vin’ /vẽ/ [vɛŋ].

In Walter (1982) and Carton et al. (1983), the majority of southern speakers maintain a four-term nasal vowel system but the variable parameters (vowel quality, nasalisation, nasal consonant presence) are subject to high levels of variation, both geographically and socially. In general, the /ẽ/-/œ̃/ contrast is maintained by southern speakers in the second half of the twentieth century, where it has been largely neutralised in supralocal French (see Section 2.2.2.2.2). Armstrong and Pooley note the following vowel quality variations, using SF as a reference point

(2010:193): /ẽ/ is often raised and realised as [ē]; /ã/ is relatively front, [ā]; /õ/ is relatively open [ō]. Carton et al. distinguish between three different levels of nasalisation: nasalised [ẽ̃], partially nasalised [v[∞]]³⁴ and denasalised [v]. Taylor (1996) distinguishes between full nasal consonants [N] and nasal consonant appendages [v^N], weak consonantal codas which often follow the nasalised vowel in the form of an offglide. Based on data from Walter (1982), Carton et al. (1983) and Taylor (1996), Pooley identifies four principal phonetic variants of the southern French nasal units (after Pooley, 2007:55): [vN] (denasalised vowel+nasal consonant); [v^N] (denasalised vowel+nasal consonant appendage); [v^{∞N}] (partially nasalised vowel+nasal consonant appendage); [ṽ] (nasalised vowel). These examples illustrate the interaction between nasal consonant presence and nasalisation: the more nasalised a vowel is, the weaker the consonantal coda tends to be. [vN] variants were attested in Martinet's (1945) data but these were receding in the more recent studies with, for example, only the oldest informants in Walter's study realising this sequence (Armstrong and Pooley, 2010:192). The majority DSP variant attested in both Walter (1982) and Carton et al. (1983) for the entire south of France is [v^{∞N}], a partially nasalised vowel followed by a weak consonantal coda which is homorganic with the following consonant³⁵. Taylor (1996) calls this variant the 'regional standard' in Aix-en-Provence, noting that a partially or fully nasalised vowel

³⁴ The partially nasalised diacritic [°] is not used in the IPA.

³⁵ Walter and Carton et al. both note that pre-pausal [ŋ] is still common in Provence and Gascony, but receding in favour of [n] and [m] in Languedoc.

followed by a weak consonantal element is more highly regarded (socially) than the fully nasalised vowel of supralocal French.

In Martinet's data, the maintenance of /*ẽ*/-/œ/ was particularly strong in the southwest (100%). Both Walter (1982) and Carton et al. (1983) suggest that the RF of Gascony has four nasal vowel phonemes, conforming to the DSP, variably realised as denasalised (or partially nasalised) vowels followed by nasal consonants with varying degrees of vowel modification. Walter notes that the vowel in each sequence is rarely completely denasalised (1982:182). The nasal consonants are homorganic with the following oral consonant and realised as [ŋ] in word-final/pre-pausal contexts. It is not clear from the data whether weaker consonantal elements, akin to those found in Aix-en-Provence by Taylor (1996), were present in the RF of Gascony. The nasal vowel system in southwestern French exhibits the following vowel qualities (Walter, 1982: 182; Carton et al., 1983: 61): /*ẽ*/ is raised to [ē]; /œ/ is realised as [œ̃]; /ā/ is centralised to [ā̃]; /ō/ is more open [ō̃]. Overall, the nasal vowel system in the RF of Gascony conforms to the DSP pattern.

2.3.1.4 CONSONANTS

For the most part, the consonantal inventory of southern RF is identical to that of SF. Martinet (1945) notes seven divergences in the speech of those born in late nineteenth century or the first half of the twentieth century. Armstrong and Pooley note that, even in the early twentieth century, regional consonantal features were receding at an alarming rate and that, in the latter part of the century, many of the consonantal variants identified by Martinet are completely absent as majority pan-southern forms (2010:189). For this reason, Pooley (2007) excludes consonantal

variation from the DSP completely: the consonantal phonology of the DSP is seen to conform, for majority forms, to that of standard or supralocal French. Walter and Carton et al.'s studies suggest, however, that Gascony was the region that retains the most non-standard consonantal forms (albeit for older, rural informants), at least in the 1980s.

Martinet notes the use of apical [r] in the south of France as a variant of SF /ʁ/. By the late twentieth century, the majority southern variants were uvular [ʁ] or pharyngeal [ʁ̠]. [r] was the majority variant used by older speakers in Gascony and Languedoc (Carton et al., 1983:61) and this was also the case for Walter's informant from the Gers (Walter, 1982:183). In fact, Armstrong and Blanchet claim that southwestern RF (Gascony, Béarn, Toulouse area) and especially rural varieties (containing marked features such as apical [r]) are 'generally considered by ordinary French speakers as a "distorted" French created through bilingualism' (2006:265).

Consonantal gemination (largely but not exclusively associated with [r]) is also cited by Martinet as a characteristic of southern RF, e.g., 'serrer' /sɛʁe/ [sɛrre]. In Walter and Carton et al.'s data, for the entire southern area, the gemination of /ʁ/ tended to co-occur with the realisation of the apical variant [r] and in word-initial position, e.g., 'rat' /ʁa/ [rra], with singleton /ʁ/ in other contexts, e.g., 'serrer' /sɛʁe/ [sere]. In Gascony, geminate apical [r] was realised both word-initially (Carton et al., 1983:61), e.g., 'royaux' /ʁwajo/ [rrwajɔ], and intervocalically (Walter, 1982:183; Carton et al. 1983:61), e.g., 'les restes' /ləʁɛst/ [lɛrɛstə].

Martinet notes the use of the palatal lateral [ʎ] as a regional variant of SF /j/, e.g., ‘travailler’ /tʁavaje/ [travaʎe]. In the 1980s, this variant was only attested in the area near the Pyrenees (i.e. in southern Gascony).

Word-final consonant devoicing was noted by Martinet as occurring with relatively low frequency (20% of southern informants) but comparisons between older and younger speakers suggested that devoiced variants were gaining ground, e.g., ‘rose’ /ʁoz/ [rrɔːz̥]. Word-final consonant devoicing was only noted in Toulouse and the Gers by Walter (1982) and Carton et al. (1983).

The /ɲ/-/nj/ contrast was maintained by the majority of Martinet’s southern informants with the palatal [ɲ] variant reported particularly by southern, and especially southwestern informants, e.g., ‘l’agnelle’ /lapɛl/ ~ ‘la nielle’ /lanjɛl/. In the 1980s data, [ɲ] also showed considerable vitality as a variant of /nj/ in all southern regions but particularly in the southwest.

Diaresis, or the disyllabic pronunciation of monosyllabic words was common for southern informants in Martinet’s data, e.g., ‘lion’ /ljɔ̃/ [li.jɔ̃^N]. Disyllabic pronunciations were a majority variant for 72% of southern informants but Walter and Carton et al. only note diaresis in the speech of informants from the Hautes-Alpes *département* and from the Languedoc, respectively.

Finally, Martinet notes that 10% of southern informants used the glottal fricative [h] in word-initial position, e.g., ‘haine’ /ɛn/ [hɛn(ə)]. Armstrong and Pooley note that this is a minority feature that occurred only in the southwest, including Toulouse (2010:190). In Walter (1982) and Carton et al.’s (1983) data,

aspirated [h] had completely disappeared from the consonantal phonological inventory of southern RF apart from a very small area limited to the deep southwestern region of Gascony (i.e. Béarn) (Walter, 1982:183).

2.4 THE LANGUAGE CONTACT STUDY

The first study in this thesis addresses the question of how the phonological system of RF arises from language contact by investigating unilateral phonological and phonetic transfer from Béarnais into French in the speech of ten older bilingual speakers (five male; five female). The study focuses on a subset of vocalic variables in Béarnais and French, using Flege's (1988, 1990, 1991) SLM to advance hypotheses about the type of transfer that will occur and, more importantly, to explain how this transfer occurs (see Section 1.1.2.2). It is important to emphasize, at this point, that the substrate languages in the south of France are clearly distinct from French, in opposition with the situation described by Hornsby (2006) which focused on northern *oïl* substrates (see Section 1.4). As such, contact between Béarnais and French is clearly a case of language contact rather than, as was the case in Hornsby's study, dialect contact.

In Chapter 1, we saw that applications of the SLM have predominantly focused on second language learners who are, in essence, speaking their L2 with a foreign accent (see Section 1.1.2.2). Bilingual Béarnais-French speakers find themselves in a very different situation from that of the foreign language learner: the L1 and L2 varieties have been involved in long-term language contact; all speakers acquired their L2 at an early age; the levels of L1 and L2 input have varied over the course of the speakers' lifetimes; the L1 language has become restricted to a small

number of highly specific domains of use; the L2 language is dominant, both socially and in terms of language use.

The SLM would classify Béarnais-French bilingual speakers as ‘early learners’ of their L2 as they began to acquire French when they entered primary education at the age of five or six. On this basis, the SLM would predict maximal ability for new category formation for L2 sounds as well as maximal ability to distinguish phonetic differences between L2 categories that are not meaningful in their L1, Béarnais. Over the course of these bilinguals’ lifetimes, French has become their dominant language as well as the dominant language of the society in which they live: input from French increased as they grew older. Levels of L1 language use and of language input have been shown to affect the L1 and L2 subsystems in different ways: ‘individuals who remain L1-dominant [...] seem to show stronger L1 to L2 effects whereas the reverse seems to hold true for individuals who become dominant in the L2’ (Flege, 2007:366). The SLM would therefore predict more L2-to-L1 influence (i.e. more influence of French on Béarnais) if the bilinguals are dominant in their L2. When investigating the genesis of RF, we must take into account this complicating factor: the original Béarnais input may have been strongly influenced by French over the course of a speaker’s lifetime. Moreover, there is insufficient data available on the nature of the original French input to the bilingual’s phonetic categories. It is very likely that it was not generally SF, since the primary input would have come from primary school teachers, normally from the region or from adjacent regions, as well as the highly accented speech of parents: ‘Southerners first contacts with French are more likely to have been through written documents and other Southerners than native speakers from Paris’ (Morin, 2009:411). Indeed, the nature of the French input (as well as the amount of French input) has evolved

steadily over the course of the bilinguals' acquisition. We have a fair idea of the multi-faceted array of contacts available to the older speakers today (neighbours, family members of all generations, speakers who have migrated from other southern regions and, more importantly, from the north of France, education, media, etc.) but this is difficult to quantify. SLM studies often include monolingual speakers of the L1 and L2 as controls to test for such effects, which, of course, is not possible in the present study.

To summarise, four potentially confounding factors must be born in mind when investigating the evidence for Béarnais to French transfer: (i) phonetic realisations in Béarnais are likely to diverge from the original monolingual categories established in early childhood due to cross-language phonetic assimilation and due to the speakers becoming L2-dominant in French; (ii) the amount of input from Béarnais and French has varied over the speakers' lifetimes (iii); the nature of the original French input is not clear and evaluating it relative to standardised categories may be problematic in some respects; (iv) the nature of French exemplars has become more varied over the course of the speakers' lifetimes. Nevertheless, the principles governing transfer in the Béarnais-French situation are the same as those described by Flege and others in situations of foreign language learning. Examining the SLM in a situation of territorial language contact may also provide a new perspective on L1-to-L2 transfer through investigating its predictions in a different sociolinguistic context but also by investigating transfer between languages that are more typologically similar than those usually examined using the SLM.

The language contact study will analyse phonological and phonetic transfer in the mid- and nasal vowels of the variety of French spoken by the bilingual speakers, the RF of Béarn. The variables selected constitute cognate or equivalent phonemes,

or sequences of phonemes, in the bilinguals' mental representation of their languages, and are thus hypothesised by the SLM to be stored in a common phonological space. In the sections that follow, the Béarnais and French mid-vowels and the Béarnais nasal units/French nasal vowels are presented separately. Following the mid- and nasal unit/vowel descriptions, the specific SLM-derived transfer hypotheses are advanced. All analyses in the language contact study will be sociophonetic in nature comprising traditional Labovian data collection techniques as well as an acoustic phonetic analysis of the data set.

2.4.1. THE MID-VOWELS

Moreux explicitly presents the RF mid-vowels of older speakers in Béarn as influenced by the variety of Gascon (or Béarnais) that they speak: 'ces traits typiques des Vieux sont reliés à la pratique du gascon' (2006:310). The Béarnais and SF mid-vowel systems exhibit a one-to-one correspondence in the front of the vowel space, e.g., Béarnais /e/ with French /e/ and Béarnais /ɛ/ with French /ɛ/, while in the back of the vowel space, Béarnais /ɔ/ corresponds to both /o/ and /ɔ/ in French. The SLM predicts different types of phonological and phonetic transfer from these correspondences and divergences between the Béarnais and French systems. This investigation of those predictions with reference to Béarnais and French will examine the front unrounded mid-vowels and the back mid-vowels of each language.

The SLM predicts that the phonemes /e/ and /ɛ/ in Béarnais will be equated, via the process of equivalence classification, with French /e/ and /ɛ/ in a common phonological space, facilitating their retention in emergent RF. This association at the phonemic category level would lead the French (L2) vowels to be realised

phonetically as instances of the Béarnais (L1) phonetic categories, [e] and [ɛ]. Via the linguistic mechanism of phonetic category assimilation, Béarnais [e] and French [e] would be realised as phonetically identical, as would Béarnais [ɛ] and French [ɛ]. For the back mid-vowels, the SLM predicts that the existence of a single back mid-vowel phonemic category in Béarnais /ɔ/ will lead to the establishment of a single phonemic category in French (for /o/ and /ɔ/) since equivalence classification would equate the two French sounds with the single sound in Béarnais as the phonetic height difference between French /o/ and /ɔ/ does not play a distinctive role in Béarnais. If such equivalence classification takes place, Béarnais /ɔ/ and French /o/ and /ɔ/ would be realised as phonetically identical, [ɔ], via the mechanism of phonetic category assimilation.

An alternative hypothesis for the back mid-vowels is that L1 Béarnais speakers will perceive the phonetic difference between French /o/ and /ɔ/, leading them to establish a new L2 phonetic category for French /o/. In this case, the process of equivalence classification would cause French /ɔ/ to be realised as an instance of the Béarnais [ɔ] phonetic category while the process of new category formation would establish an additional phonetic category, [o], for French /o/.

We may also note that bilinguals may be (subconsciously) aware of the structural relationship between the phonologies of Béarnais and French (see Section 2.2.2.1). For example, Béarnais /u/ and French /ɔ/ both evolved from Latin O and, as such, share quasi-parallel distributions in their respective phonologies. These

associations are evident in loan words from one language into the other, e.g., French ‘association’ /asɔsjasjɔ̃/ > *assoussiaciou* /asusja'sjũ/ in Béarnais. The association of French /ɔ/ and /o/ with Béarnais /ɔ/, and not with Béarnais /u/, may therefore be interpreted as a case of ‘under-differentiation’: a process whereby L2 sounds are assigned to the nearest perceptually similar L1 phonetic category with which they have no structural relation, over-riding equivalence classification. Instances of transfer involving Béarnais /u/ and French /ɔ/ have not been noted in any descriptions of ‘contemporary’ RF. For example, we have not seen any evidence that ‘bol’ /bɔl/ is pronounced as [bul]. Moreux (1995, 2006) notes, however, that in D’Aubigné’s *Les aventures du Baron de Faeneste* (1617-1630), the character of Faeneste, a mother-tongue Gascon speaker, pronounces SF ‘chose’ /ʒoz/ as ‘chouse’ [ʒuz(ə)], and that grammarians criticised this type of pronunciation up until the early twentieth century (2006:312). Therefore, we must consider the possibility that French /ɔ/ may be systematically related to the Béarnais /u/ by the bilingual speakers.

2.4.2. THE NASAL UNITS

While mapping the structural correspondences between the Béarnais and French mid-vowels was relatively straightforward, from both a diachronic and synchronic perspective, a comparison of the Béarnais nasal units and French nasal vowels reveals a complex array of structural equivalence classes which, for the most part, are not in one-to-one correspondence. It is for this reason that I have chosen to examine these variables in the language contact study: the application of the SLM to

two very different, but historically related, systems in contact predicts processes such as new category formation and under-differentiation, which override equivalence classification.

The language contact study will examine the five Béarnais nasal units /iN ʏN ēN āN ũN/, which may be realised as sequential [iN ʏN ēN āN ũN] or non-sequential [i ʏ ē ā ũ] units, and whose distribution is lexically specified. As shown in Section 2.2.2.2, the presence or absence of a nasal consonant is also conditioned by syllable type: [ṽN] in medial open and final closed syllables; variable in final open syllables depending on whether the syllable in the Latin etymon was closed or late-closed. For this reason, each variable will also be investigated in three syllabic contexts: final open syllables (/Cṽ#/), final closed syllables (/CṽC#/), and medial open syllables (/CṽCV(C)#/). As we have seen, vowels in both sequential and non-sequential units are traditionally viewed as nasalised (cf. Séguy and Allières, 1954-1973; see Section 2.2.2.2) but we may note the possibility for vowels in word-final non-sequential units, e.g., *plâ* /plāN/ [plā], to be fully denasalised, [pla]. When there is a nasal consonant it may vary in place of assimilation due to assimilation to the following phonetic environment.

The analysis of French assumes as its starting point the four conservative nasal vowel phonemes, /ā ē ɔ œ/. The presence of a nasal consonant coda is variable in southern RF and there may again be an effect of place assimilation. Additionally, Taylor (1996) notes that the presence of a nasal consonant in southern RF appears to be directly (negatively) related to the degree of nasalisation of the preceding vowel. The nasal vowels will be examined in three syllabic contexts, parallel to those used

for the Béarnais nasal units, to investigate the effect of syllabic structure on nasal consonant presence: final open syllables (/C $\tilde{v}$ #/), final closed syllables (/C $\tilde{v}$ C#/), and medial open syllables (/C $\tilde{v}$ CV(C)#/).

From a historical perspective, the French nasal vowels /œ̃/ and /ɔ̃/ map directly onto the Béarnais nasal units /ỹN/ and /ũN/ (see Section 2.2.2.2): there is a one-to-one correspondence between these phonological units in the surface phonologies. The SLM would predict these phonemic cognates to be equated and for L2 cognates to be realised as instances of L1 phonetic categories (via phonetic category assimilation). The relationship between French /ẽ̃ ã̃/ and Béarnais /ĩN ẽN ãN/ is more complex. The evolution of French and Béarnais from Latin allows us to identify the following systemic correspondences or potential equivalence classes (Section 2.2.2.2): French /ẽ̃/ maps structurally onto Béarnais /ĩN/, /ẽN/ and /ãN/, e.g., French ‘vin’ /vẽ̃/, ‘plein’ /plẽ̃/, and ‘chien’ /ʃẽ̃/, correspond to Béarnais *bĩ* /bĩN/, *plê* /plẽN/ and *câ* /kãN/. French /ã̃/ also maps structurally onto Béarnais /ẽN/ and /ãN/, e.g., French ‘cent’ /sã̃/ and ‘sang’ /sã̃/ correspond to Béarnais *cén* /sẽN/ and *sanc* /sãNk/.

When the phonological systems of two languages in contact exhibit highly complex structural relationships between them, or when the phonetic realisation of an L2 sound is sufficiently perceptually different from that of its corresponding L1 sound, the SLM predicts that the processes of under-differentiation or new category formation may apply. Given the disaccord between the surface phonologies of Béarnais and French as well as the potential phonetic dissimilarity between the

components of some structural equivalence classes, it is likely that processes other than equivalence classification (and phonetic category assimilation) may apply.

When an L2 sound is sufficiently phonetically different from its structurally corresponding L1 sound, the SLM may assign the L2 sound to the nearest perceptually similar L1 phonetic category instead, thus blocking equivalence classification by under-differentiation. As result of this, we might expect French / $\tilde{\epsilon}$ / to be processed and produced as an instance of the Béarnais [$\tilde{\epsilon}$ N] phonetic category given their perceptual similarity. Likewise, we might expect French / $\tilde{\alpha}$ / to be realised as a variant of the Béarnais [$\tilde{\alpha}$ N] phonetic category. The L2 sounds would thus be dissociated from their underlying structural equivalents in the L1 (/iN/, / $\tilde{\epsilon}$ N/, and / $\tilde{\alpha}$ N/ for French / $\tilde{\epsilon}$ /; Béarnais / $\tilde{\epsilon}$ N/ and / $\tilde{\alpha}$ N/ for French / $\tilde{\alpha}$ /).

Alternatively, new category formation may block equivalence classification and cause the creation of a new L2 phonetic category for French sounds that are perceptually dissimilar from any L1 Béarnais sounds: it is possible the French / $\tilde{\epsilon}$ / and / $\tilde{\alpha}$ / will form new phonetic categories in the bilingual vowel space, either because they are judged to be sufficiently phonetically different from any L1 nasal unit phonetic categories or because of the opacity of the complex structural relationship between the French and Béarnais systems for these units. It is equally possible that the French nasal vowels for which there is a one-to-one correspondence with Béarnais nasal units, / $\tilde{\alpha}$ / and / $\tilde{\epsilon}$ /, may also be assigned to new L2 phonetic categories because of perceptual dissimilarity with phonetic realisations of corresponding Béarnais categories, [$\tilde{\epsilon}$ N] and [$\tilde{\alpha}$ N].

Finally, transfer may also occur of the nasal consonant coda distribution from Béarnais into French. Morin notes, in the sixteenth century RF of Marseille:

‘la prononciation caractéristique des français méridionaux qui rendent les voyelles nasales de la norme parisienne moderne par des suites *Voyelle + Coda nasale*, avec une voyelle plus ou moins nasalisée et une coda plus ou moins réduite [...] semblables aux suites *Voyelle + Coda nasale* du substrat provençal.’

(Morin, 2005:5)

Similarly, we might expect the transfer of nasal consonant codas from Béarnais into the RF of the bilingual informants: phonetically sequential variants in medial closed and final closed syllables; variability between sequential and non-sequential variants in final open syllables depending on whether the vocalic element was in a closed or late-closed syllable in the Latin etymon.

2.5. THE DIALECT CONTACT STUDY

Over the course of the twentieth century, Béarnais was gradually ousted from all domains by the dominant French language. This reduction in domains was accompanied by rapid language shift and an abrupt cessation in intergenerational transmission during the aftermath of the Second World War. Consequently, those born in Béarn (after 1955-60) to Béarnais families are almost exclusively French-speaking monoglots. The subsequent rise of industrialisation, social-mobility and immigration to the region has led to another type of contact situation: the RF that had emerged from language contact has been in contact with incoming varieties of French for some time, the most notable of which is the supralocal northern norm. This contact between RF and incoming supralocal French in Béarn has thus led to a situation of dialect contact in that the varieties in contact are dialects of the same language. The RF of Béarn has also, of course, been in contact with other adjacent varieties of southern RF.

The dialect contact study examines the evolution of RF over time by comparing the production of the mid- and nasal vowels by the bilingual speakers with that of two younger generations of speakers. The aim of this analysis is to track linguistic change in the variety after the ‘dust of contact’ has settled to identify the mechanisms responsible for these changes and to address the question of whether it is accurate to characterise RF as ephemeral ‘substrate residue’, that is, local features are lost in favour of northern supralocal forms (see Introduction).

Linguistic changes identified in the RF of Béarn will be interpreted using Kerswill’s (2003) Regional Dialect Levelling (RDL) model. According to Kerswill’s model, the adoption into the RF of Béarn of DSP features would indicate that levelling ‘proper’ is taking place in the variety (the loss of marked local features in favour of unmarked features with broader, but still relatively local currency), while the presence of supralocal French features would indicate that geographical diffusion is the more likely mechanism of change.

We must note, at this point, that the older (bilingual) speakers in the present study would have been aged between 38 and 59 when the data for the studies by Walter (1982), Carton et al. (1983), and Moreux (1985a, 1985b, 2006) were collected and are thus younger than the oldest speakers in those studies. They would, for example, have been included in the middle or ‘intermediate’ generation by Moreux.

2.5.1 THE MID-VOWELS

In SF, the distribution of the front mid-vowels, /e/ and /ɛ/, is dependent on syllable type: /ɛ/ always occurs in final closed syllables; the *loi de position* is observed in

non-final syllables with [ɛ] in closed syllables and [e] in open syllables; /e/ and /ɛ/ are contrastive in final open syllables. In supralocal French, /ɛ/ occurs in final closed syllables; intermediate realisations, [e] for /e/ and [ɛ] for /ɛ/, are common in non-final syllables; in final open syllables, the contrasts of SF are neutralised in favour of a close vowel, [e]. In the DSP, as observed in the 1980s, the front mid-vowels follow the *loi de position* in all contexts, [e] in open syllables and [ɛ] in closed syllables, thus neutralising the standard phonemic contrast in final open syllables. In the RF of Gascony, both Walter (1982) and Carton et al. (1983) suggest that [ɛ] was used in all syllable types in the speech of older informants: the standard contrast in final open syllables was thus neutralised to /ɛ/; the *loi de position* was not present. Moreux's (1985a, 1985b) findings in Béarn contradict this, suggesting that, while older informants maintained an /e/-/ɛ/ contrast in final open position, there was a strong tendency for speakers in the middle and younger generations to follow the *loi de position* (and thus neutralise the contrast).

The neutralisation of phonemic contrast in final open syllables for the front mid-vowels, via the adoption of the *loi de position*, in the RF of Gascony or Béarn would constitute evidence of levelling 'proper': the RF of Béarn would be adopting the majority southern variants for the front mid-vowels. A gradual reduction in the phonetic distinction between /e/ and /ɛ/, particularly in non-final and final open syllables, would indicate, on the other hand the mechanism of geographical diffusion whereby features of the supralocal norm are adopted into RF. Diffusion of the conservative standard, on the other hand, would see the adoption into RF of a

contrastive distribution for the front mid-vowels in final open syllables and the use of the *loi de position* in non-final syllables.

The SF distribution of the back mid-vowels is also conditioned by syllable type: /o/ always occurs in final open syllables; /o/ and /ɔ/ are contrastive in some final closed syllables; the *loi de position* applies in non-final syllables. In supralocal French, the standard distribution is maintained, although there is evidence to suggest that there has been an increase in the use of intermediate phonetic variants, particularly in non-final and final open syllables, indicating a possible gradual phonetic merger of the back vowels (see Section 2.2.2.1.3). In the DSP, the back vowels were shown to follow the *loi de position* in all contexts thus neutralising the standard contrast in all final closed syllables. For Gascony, many speakers were shown to have the *loi de position* (following the DSP) while others used [ɔ] in all contexts. The actual phonetic realisation of this vowel is said to be somewhere between [o] and [ɔ] (Carton et al., 1983; Moreux, 2006). While Moreux (1985a; 1985b) acknowledges the use of a single open back mid-vowel by some RF speakers in Béarn, he indicates, as for the front mid-vowels, that there is a tendency for most older speakers and younger generations of speakers to use the DSP pattern.

The adoption of the *loi de position* for the back vowels may indicate the focusing mechanism of levelling ‘proper’ whereby the DSP feature is integrated into the RF of Béarn. The use of intermediate phonetic variants, particularly in non-final and final open syllables, and the maintenance of contrast in final closed syllables would indicate the adoption of the supralocal French system in RF via geographical diffusion. Diffusion of SF, on the other hand, would be characterised by the use in

RF of a close vowel in final open syllables, the *loi de position* in non-final syllables and the maintenance of contrast in final closed syllables.

2.5.2 THE NASAL VOWELS

From a phonological perspective, we have seen that the SF nasal vowel system contains four vowels / $\tilde{e}$ $\tilde{o}$ $\tilde{a}$ $\tilde{\omega}$ / while supralocal French has three vowels / $\tilde{e}$ $\tilde{a}$ $\tilde{\omega}$ / as a result of the merger of / $\tilde{e}$ / and / $\tilde{o}$ /. The DSP also has a four-term nasal vowel system and there is no evidence to suggest that the southwestern phonological pattern diverged from the DSP.

The standard and supralocal nasal vowels are realised phonetically as fully nasalised vowels: open-mid front unrounded [$\tilde{e}$], open back unrounded [$\tilde{a}$], open-mid back rounded [$\tilde{\omega}$], and, for SF, open-mid front rounded [$\tilde{o}$]. The southern vowels are generally held to have three variable phonetic parameters: vowel quality is traditionally modified such that / $\tilde{e}$ / is higher [$\tilde{e}$], / $\tilde{a}$ / is central [$\tilde{a}$] and / $\tilde{\omega}$ / is more open [$\tilde{\omega}$]; nasalisation is variable; nasal consonant codas frequently accompany nasal vowels, e.g., [$\tilde{e}N$], [$\tilde{o}N$], [$\tilde{a}N$] and [$\tilde{\omega}N$].

Evidence for supralocalisation in the nasal vowel system of the RF of Béarn may take two forms: either the retention of a four term nasal-vowel system in line with the DSP or a three-term supralocal system, adopted via geographical diffusion. Changes in vowel quality, the lowering of / $\tilde{e}$ / from [$\tilde{e}$] to [$\tilde{e}$] and the backing of / $\tilde{a}$ / from [$\tilde{a}$] to [$\tilde{a}$], may also indicate supralocalisation via diffusion. A reduction in the use of nasal consonant codas would also indicate diffusion of the supralocal norm

whereas their retention would signal the (continued) use of the majority southern variant (DSP).

2.6 CHAPTER SUMMARY

This chapter has presented the contact situation in Béarn, the phonological and phonetic systems of Béarnais, Occitan and French as well as a selection of impressionistic data on the RF of the south of France. Additionally, the contextual and linguistic foci of the two studies of this thesis, the language contact and dialect contact studies, were outlined.

The history of French in the region of Béarn emphasised that language contact between Béarnais and French was largely absent, among lay-speakers in the region, until the late nineteenth century. Since then, however, Béarnais has been gradually ousted from all domains by French via the socio-political process of language shift. A sociolinguistic profile of the remaining Béarnais speakers aimed to provide further contextual information on the modern-day status of language contact. The difficulty in distinguishing, both socially and linguistically, between the language varieties present in the region of Béarn was also addressed.

A comprehensive overview of the phonological inventories in contact in Béarn highlighted the parallels and divergences, from an etymological and synchronic perspective, between Béarnais, Occitan, SF and supralocal French. A phonological description of southern RF, drawing primarily on the studies of Martinet (1945), Walter (1982) and Carton et al. (1983), aimed to identify divergences from standard and supralocal norms as well as, importantly, the degree of conformity of the southwestern RF vowel system to what Pooley (2007) refers to

as the DSP. Variability in the mid- and nasal vowels was suggested to be high in southern RF, while regional consonantal variation was highly recessive.

The language contact study was then outlined, viewing RF phonology as resultant from language contact between Béarnais and French. This study aims to examine phonetic and phonological transfer from Béarnais into French, focusing explicitly on the mid- and nasal vowels. I proposed to investigate the genesis of RF using Flege's SLM in order to identify the linguistic mechanisms which facilitate the transfer of structural features. This analysis will assess the claim the RF is a result of 'substrate residue', with the concomitant aim of determining why some features may transfer during language contact and not others.

Finally, the dialect contact study was presented which aims to investigate language variation and change in the RF of Béarn over time. I proposed to analyse the mid- and nasal vowels in the speech of three different generations, using an apparent-time methodology. The dialect contact study aims to assess the claim that RF is ephemeral and as such examines the loss and retention of regional phonetic and phonological features in the variety. The outcomes of increasing contact between RF and other contemporary varieties of French will be examined within the framework of Kerswill's (2003) model of RDL.

CHAPTER 3

METHODOLOGY

« On était dépourvu d'instruments d'analyse phonétique sophistiqués [...] je cherche à approfondir l'étude du système de la langue à partir du langage concret [...] Les données les plus solides, les plus objectives, sont, je crois, les données de la production spontanée. »

(William Labov, *Le changement linguistique*, 1983)

This chapter presents the methodology employed in the language and dialect contact studies. The presentation begins with the sample design, including fieldwork sites and informant selection procedures as well as the data elicitation techniques used in both studies to build a corpus of naturalistic speech for Béarnais and French. Finally, a detailed description of the analytic techniques employed is presented: transcription and segmentation protocols; acoustic phonetic analysis; normalisation procedures; auditory analysis; coding schemas used to quantify variation in Béarnais and French (including dependent and independent variables) and statistical modelling techniques.

3.1 DATA AND METHOD

3.1.1 FIELDWORK SITES

Three *communes* to the south and southwest of Pau, Pyrénées-Atlantiques, were chosen as fieldwork sites based on defined criteria: proximity to the regional capital, Pau; regular transport links to the regional capital; semi-urban demographical and

geographical characteristics. These semi-urban fieldwork sites were included in the study to allow for an analysis of both language contact and dialect contact: each location needed to be sufficiently rural in order to facilitate the selection of an older generation of bilingual French-Béarnais informants (who are almost entirely absent from Pau).

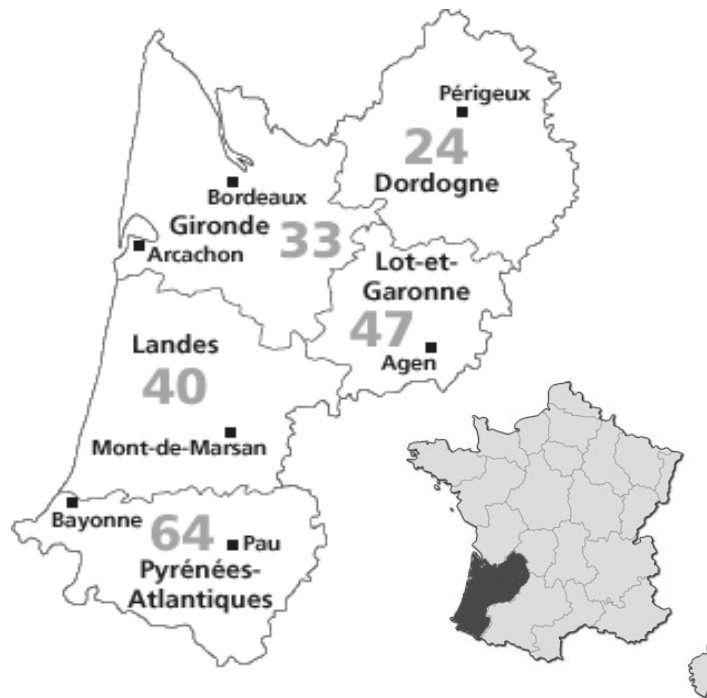


Figure 3.1. Map of Aquitaine and *Chefs-lieux de région/département*.

Pau is the second largest urban centre in the region of Aquitaine (see Figure 3.1), after Bordeaux, with a population of 84,763 in 2009 (INSEE, 2012) but its greater urban area has a population of approximately 198,000 inhabitants. The demographic evolution of Pau was rapid in the latter half of the twentieth century: it had a population of only 48,320 in 1954 (INSEE, 2012). This rapid growth is due to large-scale in-migration following the discovery of natural gas at nearby Lacq in the 1950s, the largest of its kind in Europe, which allowed France to be completely self-sufficient in natural gas for some thirty years afterwards. The gas discovery not only attracted manual labourers to the area but also led to the establishment of the Total

scientific research institute, the largest research centre for the exploration and production of natural gas in Europe, which attracted many geo-scientists and skilled workers to Pau. Pau is served by an international airport and the *TGV Atlantique* high-speed rail network with links to Bordeaux in two hours. The national *TGV* network links Pau to Paris in five hours and intercity trains and motorways link it to other large urban centres such as Toulouse and the Bayonne-Anglet-Biarritz conurbation.

The first fieldwork site, Gan, is a *commune* that lies 9km south of Pau (see Figure 3.2), to which it is connected by both national and regional roads and by regular regional bus services. Gan is also served by the TER Aquitaine (*Train Express Régional*) which links it eight times daily to Pau and Oloron Sainte-Marie, a *commune* of approximately 11,000 inhabitants in western Béarn. There are four schools in Gan, three primary-level and one pre-school, with older children having to travel to adjacent *communes* for secondary-level education. The population of Gan in 1945 was 2,643 and this has doubled in size in the latter half of the twentieth century, recorded as 5,410 in 2009 (INSEE, 2012). Gan has gradually become part of Pau's *aire urbaine* over this period and, consequently, its links with the regional capital have strengthened. Nonetheless, it can be considered as a semi-urban site adjacent to both densely populated urban areas and rural towns and villages.

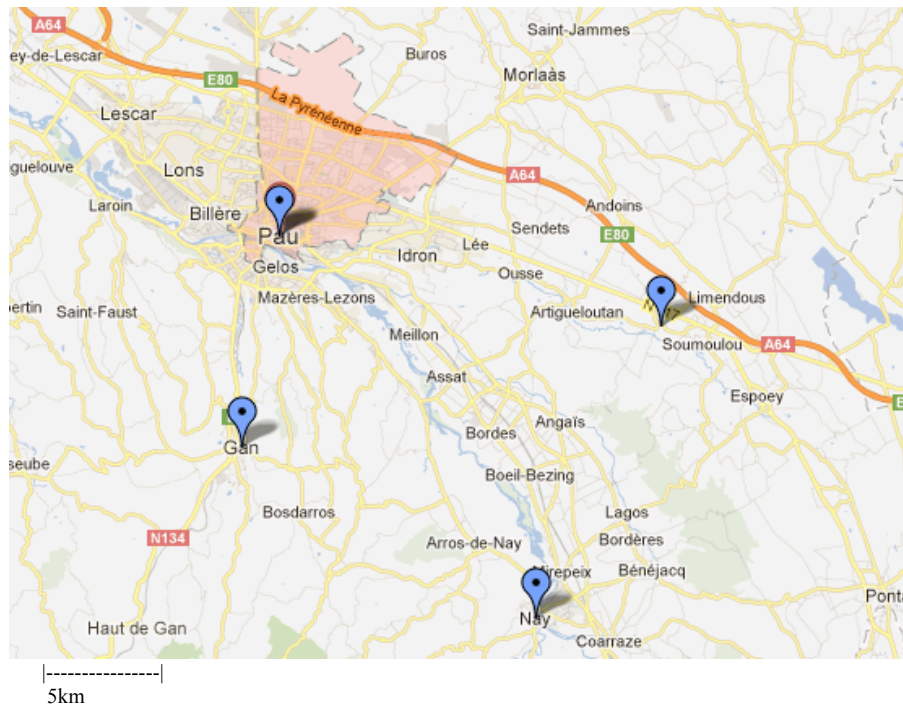


Figure 3.2. Map of Pau and Fieldwork Sites.

The second fieldwork site, in the *commune* of Nousty, is approximately 16km east of Pau (see Figure 3.2). It is also connected to Pau by both national and regional roads but is not served by regional or national rail networks. The nearest train station is in Soumoulou, 1.5km from Nousty, with connections to Pau every thirty minutes. Nousty and Soumoulou each have a primary school, with older children travelling to Pau or nearby *communes* for secondary education. The population of Nousty in 2009 was 1441 (INSEE, 2012) which is notably lower than that of Gan but Nousty is nonetheless well connected to Pau.

The final fieldwork site selected was Nay, a *commune* 19km south of Pau. Nay is approximately half way between Pau and Lourdes and holds a relatively central location within the region of Béarn. It is also served by regional roads, connecting it to both Pau and Lourdes and by national rail services between Toulouse and Bayonne. Administratively, it is also considered to form part of Pau's *aire urbaine*. The population of Nay is fairly stable, rising only by 1% per annum,

with 3,269 inhabitants in 2009 (INSEE, 2012). While the total population of Nay is relatively low in relation to a *commune* such as Gan, its status as a regional centre is evident from its education provision: two pre-school/primary schools and four secondary-level schools (two *collèges* and two *lycées*). Thus, Nay provides secondary education for many other *communes* in southern and southwestern Béarn.

The three fieldwork sites outlined here evidently display some heterogeneity in terms of their distance from Pau as well as in their demographic characteristics (population size, educational provisions, transport links). All locations selected do, however, meet the criteria for inclusion in the present study (p. 145-146).

3.1.2 INFORMANT SELECTION

For the language contact study, informants were selected based on specified criteria: residents of semi-urban areas in the Pau region; native speakers of Béarnais; resident in Béarn for their entire life; parents and/or grandparents spoke Béarnais to them. The dialect contact study encompasses a much larger population: residents of semi-urban areas in the Pau region; have lived all their life in Béarn; parents also grew up in Béarn. The removal of the criterion that informants must speak Béarnais from the sampling universe of the dialect contact study allowed for a variety of ages to be included.

3.1.2.1 STRATIFICATION AND SAMPLE SIZE

The sample structure for the language contact study, stratified by biological sex, with five speakers per cell, is outlined in Table 3.1.

Male	Female
5	5

Table 3.1. Sample structure for language contact study.

Each of the ten speakers from the language contact study was also included in the sample for the dialect contact study, as the oldest generation in an exploration of change in apparent time. Thus, as well as considering speaker sex as an independent variable, the dialect contact study also introduces the variable of age. Three broad-category generations have been used to classify speakers: older (65+ years); middle (30-50 years); young (16-18 years). These age groups were chosen to reflect different life-stages as recommended by Milroy and Gordon (2003): retirement, the working-world, and secondary school, respectively. The sample structure for the dialect contact study, with five speakers per cell, is presented in Table 3.2.

Age	Male	Female
Older (65+)	5	5
Middle (30-50)	5	5
Young (16-18)	5	5

Table 3.2. Sample structure for dialect contact study.

3.1.2.2 LOCATING AND SELECTING INFORMANTS

Milroy and Gordon note that in minority language situations, ‘random selection from a sample frame such as an electoral register will be both inadequate and inefficient’ (2003:27) because random sampling methods will often only locate monolingual speakers of the dominant language. It is thus necessary in such situations to explore other sampling methods.

Informants for both studies in this thesis were sourced using a ‘quota sampling’ technique. Quota sampling, or ‘judgment sampling’ involves ‘a process of selection based on familiarity with the community in question, targeting sectors best representing the overall community’ (Taylor, 1996:29) whereby ‘the researcher identifies in advance the types of speakers to be studied and then seeks out a quota of speakers who fit the specified categories’ (Milroy and Gordon, 2003:30). In order to fill the cells for the quota/judgment sample, I adopted a ‘friend-of-a-friend’ technique, also known as a ‘snowball technique’ or ‘network sampling’. The technique involves entering the community and contacting potential informants via an intermediary and/or utilises the social networks of participants in the study to recruit potential new participants (Milroy and Gordon, 2003:32). The motivation behind this technique is simple:

‘If a stranger is identified as a friend of a friend, he may easily be drawn into the network’s mesh of exchange and obligation relationships. His chances of observing and participating in prolonged interaction will be considerably increased.’

(Milroy, 1980:53)

Potential informants were proposed by contacts in the *Institut Béarnais et Gascon*, Pau, and were selected based on the specified inclusion criteria. The older bilingual group and the middle group were selected from all three of the fieldwork sites. The young group were all students at the *Collège-Lycée saint Joseph* in Nay but originated from a variety of different places in the region. Nay is the only fieldwork site with secondary education facilities and, as we have seen, it provides educational facilities for many of the surrounding *communes* in the central Béarn region.

3.1.2.3 THE SAMPLE

The participant profiles for the language contact and dialect contact studies are presented in Tables 3.3 and 3.4.

Speaker No.	Pseudonym	Speaker I.D	Sex	Age Group	Age	Place
001	Geneviève	A	F	65+	73	Gan
002	Julie	B	F	65+	78	Gan
003	Jeanne	C	F	65+	72	Nay
004	Marine	D	F	65+	68	Nay
005	Margaux	E	F	65+	73	Gan
006	Benoît	F	M	65+	89	Nousty
007	Arthur	G	M	65+	71	Nousty
008	Julien	H	M	65+	72	Nay
009	Arnaud	I	M	65+	77	Gan
010	André	J	M	65+	86	Gan

Table 3.3. Participants in the language contact study.

Speaker Number	Pseudonym	Speaker I.D	Sex	Age Group	Age	Place
011	Marie-Laure	K	F	30-50	47	Nousty
012	Marie-Claire	L	F	30-50	49	Nousty
013	Irène	M	F	30-50	39	Gan
014	Françoise	N	F	30-50	47	Nay
015	Céline	O	F	30-50	39	Gan
016	Jean-Paul	P	M	30-50	48	Gan
017	Victor	Q	M	30-50	33	Nay
018	Jean-Louis	R	M	30-50	42	Gan
019	Jules	S	M	30-50	37	Gan
020	Jean-Pierre	T	M	30-50	43	Nousty
021	Pénélope	U	F	16-18	17	Nay
022	Laure	V	F	16-18	18	Nay
023	Charlotte	W	F	16-18	16	Nay
024	Marie-Jeanne	X	F	16-18	18	Nay
025	Diane	Y	F	16-18	17	Nay
026	Sébastien	Z	M	16-18	16	Nay
027	Julien	@	M	16-18	17	Nay
028	Alexis	\$	M	16-18	16	Nay
029	Paul	£	M	16-18	16	Nay
030	Charles	€	M	16-18	16	Nay

Table 3.4. Additional participants in the dialect contact study.

3.2 DESCRIPTION OF THE CORPUS

3.2.1 RECORDING EQUIPMENT

Participants were interviewed individually and the corpus was recorded using a Marantz PMD661 Solid State Sound Recorder. The recordings were initially stored on a Secure Digital (SD) 4GB Memory Card before being transferred to a Macbook portable computer and backed-up to a BIPRA 2.5 500GB External Hard Drive. All sound files were recorded and stored in .wav format on two channels (stereo) with one channel for the interviewer and the other for the participant.

The sampling rate used for the recordings of this corpus was 44.1 kHz (uncompressed linear PCM recording), using a 16-bit PCM sample size. Recording levels were routinely checked throughout the recordings to ensure that no high (or ‘over’) amplitudes in the speech signal were clipped. Two battery-powered AT803 condenser microphones, with a frequency response of 30-20,000 Hz, were connected by 3-pin XLR input cables to the Marantz Recorder. Condenser microphones offer greater response and sensitivity and a louder output (Cieri, 2011:28). The AT803 microphone is designed to be worn as a lavalier which provides good quality recordings through a combination of near and unobtrusive placement. The microphone was positioned approximately six inches below the speaker’s chin using a clothing clip. Care was taken to anticipate movements that may cause the microphone to rub against or be covered by clothing and to not place the microphone in the shadow of the speaker’s chin. Every effort was made to chose a recording setting which avoided the possibility of recording echo and/or extraneous noise such as, for example, holding interviews in smaller rooms with soft furnishings.

3.2.2 DATA ELICITATION

Different data elicitation techniques were used for the language contact study and the dialect contact study: all informants had a sociolinguistic interview in French, and for the language contact study this was supplemented with a translation task from French to Béarnais (See Table 3.5).

Language Contact Study	Dialect Contact Study
French Casual Speech Data	French Casual Speech Data
Béarnais Wordlist Translation Data	

Table 3.5. Corpora for language contact and dialect contact studies.

3.2.2.1 CASUAL SPEECH DATA

A sociolinguistic interview was conducted with each speaker in the corpus to elicit casual speech. The objective of a sociolinguistic interview is to observe the participant's relaxed, 'natural' or vernacular language use by encouraging them to engage in 'narratives of personal experience' (Tagliamonte, 2006:38) by focusing the interview around a series of conversational 'modules' or 'resources' (Labov, 1973). These narratives of personal experience, or stories about the participants' own lives, are hypothesised to elicit speech reflecting their most normal usage, or at least the most normal usage possible while engaging in a recorded conversation with a relative stranger.

The organisation of the sociolinguistic interview around conversational modules allows for a semi-structured method of data elicitation: the conversation appears relaxed and 'natural' between both the participant and the interviewer but may be directed and guided by the interviewer in order to focus the conversation and

to keep it flowing. The choice of topics used with each participant varied depending on their age but modules that tended to elicit more casual speech include childhood, schooling, working, hobbies and family. An example of the ‘childhood’ conversational module from the interview schedule used with the older group of informants is included in Appendix 3A. Note the progression of the questions from ‘childhood’ generally to more specific questions on ‘schooling’ and ‘minority language use’, illustrating the organisation of modules into ‘conversational networks’ (Milroy and Gordon, 2003:59; Labov, 1984:35). In each of the thirty sociolinguistic interviews in the corpus, care was taken to allow the informant to talk as much as possible. In fact, Labov’s test of a good interview (Tagliamonte, 2006:39), which involves listening to who is speaking at five-minute intervals throughout the entire interview, with the ideal situation being that the participant is speaking, confirms overall that the informants contributed substantially more to the conversation than the interviewer. In a typical sixty-minute interview, sampling showed that the interviewer was only speaking at one or two of the twelve test points.

In the quest for casual speech, one must take account of the effect that the interviewer’s presence in the conversation will have on the variety of speech produced by the participant, in terms of the dynamic process of speech accommodation (see Section 1.3.1). The fact that the interviewer may not be part of the speaker’s normal environment can alter how the interviewee speaks, leading to Labov’s observer’s paradox: ‘we want to observe how people speak when they are not being observed’ (Milroy and Gordon, 2003:49). I interviewed all informants in the corpus in order to control for the effect of changing the interviewer. I was a 26 year old white Irish male who had lived in France for extended periods of time: Nice (2005-2006) and Paris (2008-2009). It is hoped that, as a native English speaker, my

variety of French would not trigger accommodation on the part of the informants (cf. Hoare, 2003, Paltridge and Giles, 1984) and that any variation in my own accent would not be sociolinguistically salient for the informants. Llamas et al. found that the variety of a non-native speaker interviewer did not hold in-group or out-group associations that were meaningful to native-speaker participants (2009:391). In this way, linguistic behaviour produced by participants in interviews with non-native speakers might arguably be seen as representing something closer to the default production patterns of the interviewee. It must be noted, however, that if my variety of French were classified relative to native-speaker norms, it would be SF or Parisian French given that I acquired French through an Anglo-Saxon educational system which focused exclusively on SF and I have spent an extended period of time in Paris. In fact, Speaker J proclaimed ‘Ah, vous n’êtes pas Français?’ some twenty minutes into the interview. In the instance where I was mistaken as a French L1 speaker, it is of course possible that the participant was accommodating towards my variety of French. In general, I made my non-L1 speaker status explicit before the interview began. It is also possible that participants may have spoken in a more standard fashion to facilitate my status as a learner but in practice this did not seem to be the case.

Beyond the issue of nativity, many different demographic characteristics of the interviewer may interact with those of the interviewee and influence the extent to which the participant approximates their vernacular usage. The general view is that the more similar two speakers are, the less likely the observer’s paradox is to complicate the interview with the ideal situation being to have the interviewer from the same social group as the interviewee (Di Paolo and Yaeger-Dror, 2011:10). However, Yaeger (1973) found that the more similar in age two speakers are, the

more likely it is that demographic out-group status will influence the interaction. Thus, it is much less likely that my presence affected the speech of the older speakers than it is that my interactions with the younger informants, using a standard form of French, caused some accommodation on their part. Nonetheless, all interviewees in both studies were faced with the same non-native interviewer and even if the younger speakers were to accommodate towards my variety of French, that accommodation would be relative to any shifts, or stability, in the speech of the older and middle groups, presented with the same interactional stimulus.

All interviews with the older and middle informants were carried out in their homes and the interviews with the younger informants were carried out at the *Collège-Lycée saint Joseph*. In order to mitigate the effect of being in a school environment, I systematically used the informal address pronoun ‘tu’ with the younger informants and explained to them that I was not a teacher and that the interview was not a test. Milroy and Gordon note Labov’s suggestion that interviews should obtain between one to two hours of speech from each speaker but that it is difficult to be categorical about the appropriate length of an interview (2003:58). Useful phonological data may be obtained in as little as twenty to thirty minutes but speakers are more likely to approximate their everyday usage over a longer period of time. All interviews ranged in length from forty-five minutes to one hour.

3.2.2.2 WORDLIST TRANSLATION DATA

At the end of the sociolinguistic interview each of the ten informants in the language contact study was asked to translate a wordlist from French into Béarnais in order to elicit phonological data on the Béarnais mid-vowel and nasal unit variables in specific contexts (see Section 2.4). The translation task collected baseline data on the

phonetic and phonological variables in Béarnais that may potentially have transferred into each speaker's variety of French. This Béarnais data will thus be compared, within the language contact study, to the French casual speech data for the ten bilingual informants.

The use of the wordlist translation task to elicit baseline data for Béarnais phonological variables is open to criticism: informants are more likely to engage in transfer when translating from one language to another than when producing casual speech. The use of a translation task to gather phonological data on Béarnais is justifiable for the following reasons: the focus of the language contact study is on transfer from Béarnais into French, the opposite direction to transfer potentially induced by the act of translating; the systematic nature of the study means that it is essential that the same variables be examined in the speech of all informants; since all informants were translating, they were confronted with the same potential stimulus for transfer.

Comparing Béarnais wordlist data with French casual speech data may be criticised for two related reasons: firstly, the systems being compared and their acoustic characteristics could, of course, vary along a style continuum; secondly this comparison appears to conflate 'style' and 'language' in that all Béarnais data are 'formal' and all French data are 'casual'. There is evidence to suggest that, during language shift, obsolescent languages experience a reduction in their style repertoire (Dorian, 1981). In a typical scenario, where one language is being ousted by an incoming dominant language, the formal registers of the obsolescent language are lost as it becomes progressively restricted to intimate or informal domains. In this case, rather than using formal or informal stylistic variants, speakers of obsolescent languages frequently switch codes, switching to the dominant language to signal a

change in register: the dominant and obsolescent languages are used as markers of style in discourse. Therefore, the effect of ‘style’ on the elicitation of the Béarnais data may be minimal, though this is speculative. The dialect contact study includes the majority of the data analysed in this thesis and focuses exclusively on French casual speech. I decided not to include any French wordlist and/or reading tasks because the thesis focuses on linguistic change in spoken RF and not on style shifting.

The procedure for the translation task was identical for all of the older informants. The translation task was always performed last in order to minimise observer’s paradox considerations during the sociolinguistic interview. Informants were presented with individual French words, each written on a record card, and asked to provide a translation in Béarnais. The advantage of using a translation task to collect Béarnais data was that informants seemed to view themselves in a position of authority, providing information to the interviewer, rather than the object of scrutiny.

The words were presented in a pseudo-randomised order which was the same for all speakers. The entire wordlist was entered into a spreadsheet in Microsoft Excel and was randomised using the “=RAND()” function which aligned the wordlist to a column of random numbers and then sorted it into numerical order, thus randomising the order of the stimuli. Care was taken to ensure that no two words containing instances of the same variable occurred next to one another. When this occurred, a method was devised which involved moving one of the words to another part of the list to break up the offending pair.

In acoustic experiments carried out in laboratory conditions, it is common practice to have informants read a wordlist three times, in three random orders ‘to

counteract presentation order effects such as list intonation which affects word length and may influence individual segments’ (Di Paolo and Yaeger-Dror, 2011:15). This was not possible in the translation task as the informants were not reading a wordlist, but providing translations, and to ask them to repeat the words would have been unnatural and counter-productive, forcing them pay more attention to their articulations, thus eliciting less vernacular-like tokens. Between the translation of each word, there was often meta-commentary on the lexical item produced and there was always a short delay as the next record card was shown to them by the interviewer. Because of the record cards, the informants were not aware of the length of the list, thus minimising potential listing effects, nor were they reading aloud. No fillers were inserted into the randomised list as eleven different target variables were originally contained in it and it was already quite substantial in length. Additionally, Di Paolo and Yaeger-Dror note that if a wordlist contains a number of different variables, ‘the tokens of one variable may serve as fillers for the others, in the sense that they distract the participant from focusing on any one variable of interest’ (2011:14-15).

The words chosen for the wordlist translation task were, on the whole, those lexical items that contain structurally equivalent/corresponding phonemic categories in both the stimulus (French) and the target translation (Béarnais). For each French word stimulus, there was a corresponding Béarnais ‘target’ word. For example, if an informant was presented with the French word ‘chambre’ /ʃɑ̃br/, it was expected that they would provide the translation *crampe* /'krampɔ/. The target words were drawn from the *Atlas Linguistique et Ethnographique de la Gascogne* (ALEG) (Séguy and Allières, 1954-1973). One hundred and twenty-five words, containing the variables under investigation, were analysed at two data points: Lasseube

(692NE) and Gélos (685SE). The ALEG does not include data points at Pau, Gan, Nousty or Nay, so these data points were chosen because they are in the same, south-central Pau region. Lasseube is a semi-rural site, 10km west of Gan and Gélos is a semi-urban site, which now forms part of the regional capital, Pau, and lies 8km north of Gan. The data from Lasseube were collected in September 1950 from one male, aged 76 and one female, aged 61. The data from Gélos were collected in February 1958 from two males, aged 50 and 84, and one female, the mother of the 50 year old male, whose age was not disclosed. It was hoped that the data collected at these data points would be indicative of the ‘target’ translation words to be expected during the translation task given that these were the lexical items used at the time when the speakers in the language contact study were acquiring Béarnais.

Milroy and Gordon suggest that a figure in excess of ten tokens for each linguistic environment to be analysed for each variable is a sensible goal (2003:164). The optimal figure would be at least thirty tokens of each variable in each varying linguistic environment. Due to the high number of variables examined in the language contact study, this was not possible and the analysis included at least fifteen tokens of each variable per speaker. The token protocol for each speaker for the wordlist translation task is provided in Table 3.6.

The Béarnais nasal units /ĩN ÿN ēN âN ũN/ only include five tokens per phonological environment, examined for each speaker giving a total of fifteen tokens per /ṽN/ variable. Constraints on the time available with each informant for the completion of the task limited the inclusion of extra tokens. The full wordlist used in the translation task is provided in Appendix 3B.

Variable	Context	Tokens	Total
/ĩN/	/Cĩ#/	5	
	/ĩCV(C)#/	5	
	/CĩC#/	5	15
/ỹN/	/Cỹ#/	5	
	/ỹCV(C)#/	5	
	/CỹC#/	5	15
/ẽN/	/Cẽ#/	5	
	/ẽCV(C)#/	5	
	/CẽC#/	5	15
/ãN/	/Cã#/	5	
	/ãCV(C)#/	5	
	/CãC#/	5	15
/ũN/	/Cũ#/	5	
	/ũCV(C)#/	5	
	/CũC#/	5	15
/e/ - /ɛ/	/Cv#/	10	
	/vCV(C)#/	10	
	/CvC#/	10	30
/ɔ/	/vCV(C)#/	10	
	/CvC#/	10	
			20
TOTAL			125

Table 3.6. Token Protocol for Béarnais Wordlist Translation Task.

3.3. ANALYSIS

3.3.1 TRANSCRIPTION AND SEGMENTATION

3.3.1.1 TRANSCRIPTION PROTOCOL

All recordings of sociolinguistic interviews and wordlist translation tasks were transcribed for each speaker in Microsoft Word as a necessary first step towards identifying tokens for analysis. The transcriptions aimed to retain as many linguistic distinctions as possible while maintaining readability of the text: SF orthography is used for French speech; the Febusian norm propagated by the *Institut Béarnais et Gascon* and most notably used in Simin Palay's (1932) *Dictionnaire du béarnais et du gascon modernes* was used for Béarnais words provided during the translation task and any Béarnais meta-commentary given. The speaker codes and pseudonyms outlined in Section 3.1.2.3 were used for all transcriptions in order to ensure the anonymity of the speakers. Additionally, names of other people mentioned during the interview were omitted from the transcriptions, as suggested by Maclagan and Hay (2011:37). The full transcription protocol is provided in Appendix 3C.

3.3.1.2 SEGMENTATION AND QUANTIFICATION

The principle of accountability requires 'that the researcher include in the analysis every token of the variable under investigation which occurs in the sample under study whether or not the token is a manifestation of the innovative variant, the conservative variants or some other form' (Di Paolo and Yaeger-Dror, 2011:18). It is only when every token has been included in the circumscribed sample that we can aim to uncover linguistic variation and change, as well as the social correlates of the variation that are leading to change. We may also note that in larger corpora, the

principle can be more narrowly specified as the ‘the first N tokens to occur’ rather than ‘every token’ (2011:23). Labov states that ‘for the section of speech being examined all occurrences of a given variant are noted, and where it has been possible to define the variables as a closed set of variants, all non-occurrences in the relevant environments’ (1982:30). The segmentation of speech in the studies of this thesis aims to adhere rigorously to the principle of accountability by systematically applying the same criteria for selection across variables and across speakers. Operationalising the principle of accountability is best achieved by marking the tokens to be segmented on an accurate transcription of the recording.

3.3.1.2.1 SEGMENTATION OF CASUAL SPEECH DATA

For the language contact study, if one of the vocalic variables occurred in a word, the word was included in the analysis. Likewise, for the dialect contact study, if one of the six French vocalic variables under investigation occurred in a word, it was included in the token file. Before coding began, the following exceptions to this basic rule were anticipated.

- (i) Lexical frequency in the corpus: Milroy and Gordon note that it is often necessary to limit the number of tokens included in a particular frequently-occurring lexical item in order to avoid potential linguistic bias in the analysis (2003:163). The amount of tokens at which to impose the ‘limit’ on counting is essentially arbitrary but should be related to the total number of tokens coded for each speaker. Tokens occurring in frequent lexical items were limited to three for each variable.
- (ii) Formulaic utterances: Tagliamonte notes that formulaic constructions exhibit exceptional behaviour for linguistic variables. This includes

metalinguistic commentary which may be interpreted as imitative and expressions where individual lexical items have become part of a larger ‘chunk’ and are being used as a discourse marker (2006:90), for example, ‘c’était comme-ça, tu-vois’ (See Section 3C.1.3 in Appendix 3C for full list). Formulaic utterances were excluded from the analysis.

- (iii) Neutralisation contexts: where unambiguous identification of the variant was compromised, usually where the same variable occurred at the end of one word and at the beginning of the next, both tokens were excluded from the analysis as reliable identification of the boundary between them was difficult (or near impossible).
- (iv) Ambiguity: items that were pronounced too quickly, quietly or with background noise were excluded as not audible enough for reliable coding.
- (v) Repetitions: tokens occurring directly after another in sequence as false starts or performance errors were not included in the analysis as inclusion of the repeated tokens would have added a disproportionate number of instances of the same form (Tagliamonte, 2006:93-94).

Segmentation of the casual speech files began at the same time-point for all thirty speakers: ten minutes from the beginning of the interview recording until sufficient token counts were extracted. It is often recommended that the time-point be chosen at a point in the interview where the participant appears to be using vernacular speech, indicated by laughter (Di Paolo and Yaeger-Dror, 2011:19) but this did not prove to be useful in the present study, as laughter was often not elicited from certain participants. I took the view that it was more important to apply the same objective

criterion for segmentation starting-point to all informants rather than to employ some subjective technique of vernacular identification.

For the French variables, the projected token counts per speaker for each variable, by phonological context, are outlined in Table 3.7 (for the language contact and dialect contact studies). Milroy and Gordon note that, as pointed out by Guy (1980), thirty tokens per speaker is an important dividing line in statistics generally between large and small samples and that thirty tokens of each variable per speaker is a reasonable objective (2003:164). It is also noted that if the number of tokens per variable is lower than ten, per phonological environment, there is a strong likelihood of random fluctuation, while a figure higher than ten moves towards 90% conformity with the predicted norm, rising to 100% with thirty-five tokens. The present study analyses fifteen tokens per variable per phonological environment investigated for each speaker, for example, the nasal vowel phonemes are investigated in three phonological environments, giving forty-five tokens per speaker for each nasal vowel overall. The optimal figure of thirty tokens per environment examined was not possible because the language and dialect contact studies include a wide range of variables in varying phonological contexts, the nature of the study is sociophonetic, involving a time-consuming methodology of segmentation and coding and time-constraints dictated, therefore, that the number of tokens per variable be restricted.

Variable	Context	Tokens	Total
/ɛ̃/	/Cɥ#/	15	
	/ɥCV(C)#/	15	
	/CɥC#/	15	45
/œ̃/	/Cɥ#/	15	
	/ɥCV(C)#/	15	
	/CɥC#/	15	45
/ã/	/Cɥ#/	15	
	/ɥCV(C)#/	15	
	/CɥC#/	15	45
/ɔ̃/	/Cɥ#/	15	
	/ɥCV(C)#/	15	
	/CɥC#/	15	45
/e/ - /ɛ/	/Cv#/	15	
	/vCV(C)#/	15	
	/CvC#/	15	45
/o/ - /ɔ/	/Cv#/	15	
	/vCV(C)#/	15	
	/CvC#/	15	45
TOTAL			270

Table 3.7. Token Protocol per Speaker for French Casual Speech Data (language contact study and dialect contact study).

3.3.1.2.2 SEGMENTATION OF WORDLIST DATA

The segmentation of the wordlist data is outlined in Appendix 3C. When the translated Béarnais word provided approximated the ‘target’ translation expected for given French stimulus (See Appendix 3B), the target variable embedded in that word was included in the analysis. Lexical items that did not conform to the target word, and thus did not contain the target variable were excluded from the analysis. For

example, for the stimulus ‘le sac’, the Béarnais target word expected was *lou sacòt*, containing the /ɔ/ variable. Speaker B, however, provided the Béarnais word *lou caba* which was excluded from the analysis.

3.3.2 ACOUSTIC ANALYSIS

Foulkes et al. note that an auditory analysis is relatively course-grained, imposing a pre-defined set of broad phonetic categories on the data which ‘may miss fine-grained detail that is not easily perceivable, but which may nevertheless be identifiable instrumentally’ (2011:60). It is for this reason that the present study applies primarily instrumental techniques. The acoustic analysis employed here involves the continuous measurement of characteristic vocalic features (formant frequencies). A crucial aspect of acoustic analysis is that systematic procedures for instrumental measurement be established and applied consistently across the data set to produce meaningful results. What follows is a detailed description of these procedures and their application for the coding of all dependent variables in the language contact and dialect contact studies. The acoustic analysis was performed in the PRAAT version 5.2.21 (Boersma, 2001; Boersma and Weenink, 2012) on a Macbook Pro running Mac OS X version 10.7.4.

3.3.2.1 DURATION

Segment duration was measured instrumentally for all vocalic variables with the primary aim of identifying the midpoint of each vowel. Establishing the onset and offset of a segment has received much attention in the literature, to be discussed below.

Di Paolo et al. note that duration is usually measured from vowel onset to vowel offset, with the transition being considered part of the vowel, rather than the consonant, while some measurement routines incorporate glides and liquid durations into the vowel (2011:98). Both inspection of the spectrogram and the waveform can help establish the existence of a segment boundary, but, where possible, measurements should be defined with reference to the waveform due to finer-grained detail in the visual depiction of the sound (Foulkes et al., 2011:63). In any case, the nature of the preceding and following segments can complicate the measurement procedures involved in determining segment boundaries.

Allen notes that there is a general agreement that boundaries between vowels and voiceless consonants are easier to locate than those between vowels and voiced consonants, nasals, liquids and glides (1978:1117). For vowels preceded by voiced and voiceless plosives, the onset measurement may be taken at the release burst of the plosive, at the first evidence of non-fricated vocal cord vibration following the release or at the beginning of the first glottal cycle in which high-frequency energy could be observed. In relation to vowels following voiceless aspirate plosives, the end of a positive VOT value is said to be the onset of striations in the second formant of the following vowel (Klatt, 1975) while Cho and Ladefoged cite the beginning of the ‘first full vibration of the vocal folds’ (1999:215). Di Paolo et al. define vowel onset in these instances as ‘the first cycle of a regular repeating pattern in the sine wave function following the release of the preceding consonant’ which corresponds to the beginning of dark bands on the spectrogram representing at least the first three formants (2011:91). Offset is similarly judged as the end of the last complete sinusoidal pattern. For vowels followed by plosives, measurement can be taken at the last glottal vibration before some particular event, such as closure, associated with

the following consonant (Allen, 1978:1179) or at the release of the following plosive, thus including the closure phase within the vowel duration (see Llamas et al., 2009:392). Other preceding and following segments with sharply-defined edges, such as taps and trills, constitute comparable environments where the measurement criteria outlined above can be employed. In the context of preceding and following plosives, taps or trills, vowel duration was measured at the onset and offset of regular repeating glottal vibration; aspiration following plosive release in the preceding environment and consonantal closure in the following environment were systematically excluded from vowel duration measurements (see Figure 3.3).

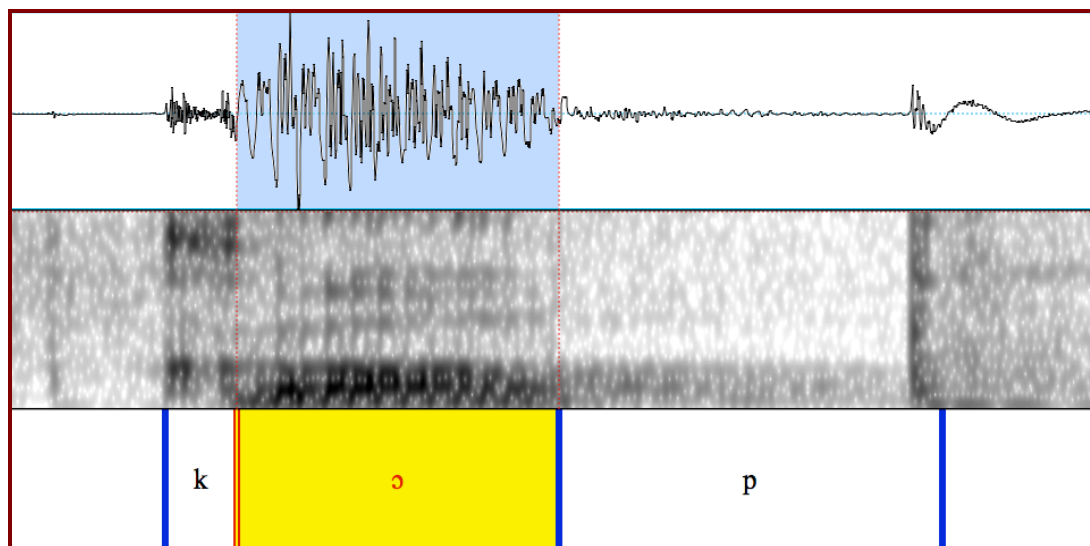


Figure 3.3. Speaker H: spectrogram of the word *cop* ('fois') with labels for vowel onset and offset.

For vowels preceded or followed by fricatives, fricative noise was never included in the vowel duration. Vowel onset and offset were determined at the points where aperiodic turbulence ended or began (or changed dramatically in intensity) and where higher formant structure became visible or invisible in the spectrogram window (see Figure 3.4).

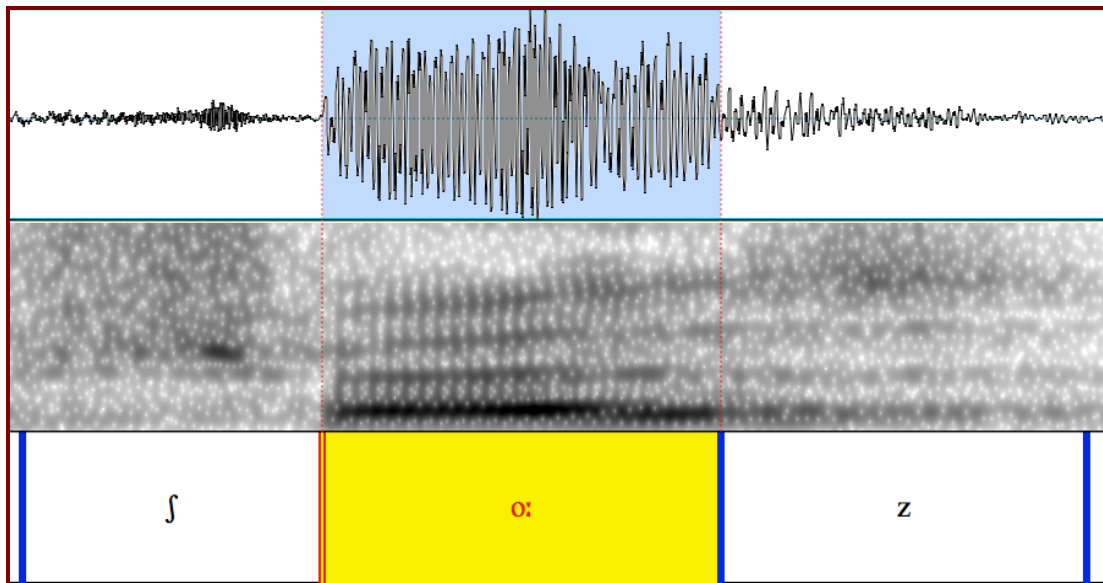


Figure 3.4. Speaker U: spectrogram of the word ‘chose’ with labels for vowel onset and offset.

For the nasal unit variables, in [ṽN] sequences, the boundaries between the vowels and following nasal consonant elements were determined at the point where sharp spectral changes occurred at the beginning of the period of oral closure. In this case, it was most useful to appeal to evidence in the spectrogram, notably a sudden drop in amplitude above F0, in order to establish the measurement point for the vowel offset (see Figure 3.5). Similarly, the boundaries between vowels and liquid consonants may be identified where the amplitude signal drops radically due to the added approximant articulation (Lawson et al., 2011:79).

Measuring the onset or offset of vowels that are preceded or followed by the glides [j] and [w] is particularly difficult as there is no abrupt boundary between these segments and the vowel and these segments are characterised by having little or no steady-state portion. In this case, Allen recommends that the boundary be drawn consistently at the point of inflection for the transition between glides and vowels (1978:1179).

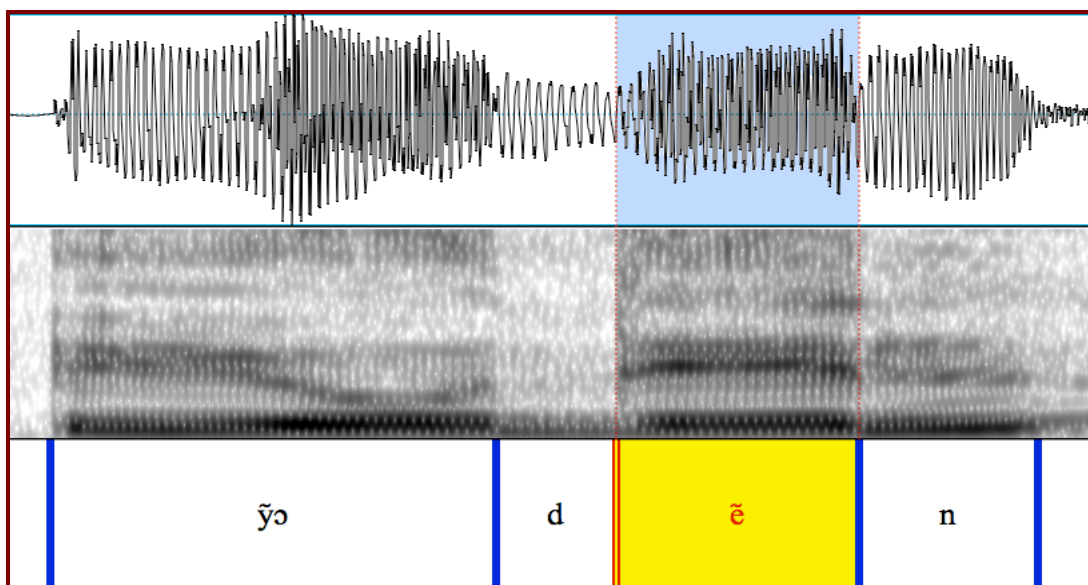


Figure 3.5. Speaker D: spectrogram of the word *ûe dén* ('une dent') with labels for vowel onset and offset.

3.3.2.2 VOWEL QUALITY

In both studies and for both languages, the acoustic analysis of the mid-vowels and of vowels in nasal units investigated vowel quality on the basis of F1, F2 and, where necessary, F3 (for rounded segments).

The procedure for measuring F1, F2 and F3 for a given vowel involves two important decisions: the location in the vowel spectrogram to measure the formants; the method used to extract the formant values. The measurement of the formants can be taken at a single point in the vowel or at multiple points, to reflect the formant's dynamic quality. Di Paolo et al. note that two basic approaches to single-point measurement have predominated in sociolinguistics: the 'point of inflection' method and the 'midpoint' method whereby both consider one point to represent the central tendency of the vowel (2011:90). The 'point of inflection' method measures the first point in the vowel that is uninfluenced by the preceding or following consonant/segment, also known as the steady-state. Where formant values are not simultaneously steady, measurement is taken at the peak amplitude and the cursor is

positioned at the highest point of energy within the visible dark band (Di Paolo et al., 2011:91). For the ‘midpoint’ method, the absolute centre of the vowel, halfway between the vowel onset and vowel offset, is chosen. This method assumes consonantal effects to be minimal at the midpoint. Multiple-measurement techniques may also be used which involve measuring formant frequencies at the vowel onset and offset as well as at several points within the moving or steady state trajectory (Di Paolo et al., 2011: 91).

The first, second and third formants were measured for each vowel token included in the analysis. These formants were estimated in PRAAT using the LPC (Linear Predictive Coding) algorithm, with a maximum of 4,000 Hz for male speakers and 4,500 Hz for female speakers. This instrumental adjustment based on biological sex was included as formant trackers may accurately track three formants below 4,500 Hz for female speakers, but may be less accurate for male speakers who might have four formants in the 4,500 Hz range (Clopper, 2011:195; Llamas et al., 2009:392). The vowel onset and offset were first labelled in a PRAAT text grid (see Section 3.3.2.1 above) and a script was used to automatically extract the value of F1, F2 and F3 at the vowel midpoint, as well as the value for vowel duration (see Figure 3.6). The PRAAT extraction script is included in Appendix 3D.

The traditional articulatory correlates of the formant frequencies are: F1 and tongue height; F2 and tongue frontness/backness; F2 and F3 and lip-rounding. Various studies have, however, shown these values to be only approximate measures of articulatory configurations because other factors, such as the distance of the point of maximum constriction from the glottis, can also have an effect on all formant frequencies (e.g., Fant, 1960): these factors are not fully accounted for in the correlations outlined above. For example, a rise in the value of F2, taken to be

indicative of fronter tongue position will also entail acoustic lowering of F1 that cannot be taken as indicative of a more close lingual configuration (Rosner and Pickering, 1994: 25) or a pharyngeal constriction will result in a high value for F1 that is not related to lingual configuration in the oral cavity (Rosner and Pickering, 1994: 29). In sum, modelling the acoustic vowel space by plotting F1 against F2 may not be a wholly accurate indication of articulatory configuration during vowel production. Taking account of these complicating factors and in line with the widespread interpretation of these correlations in sociophonetic studies of language variation and change, the studies of this thesis will nonetheless use the first three formant frequencies to model vowel quality.

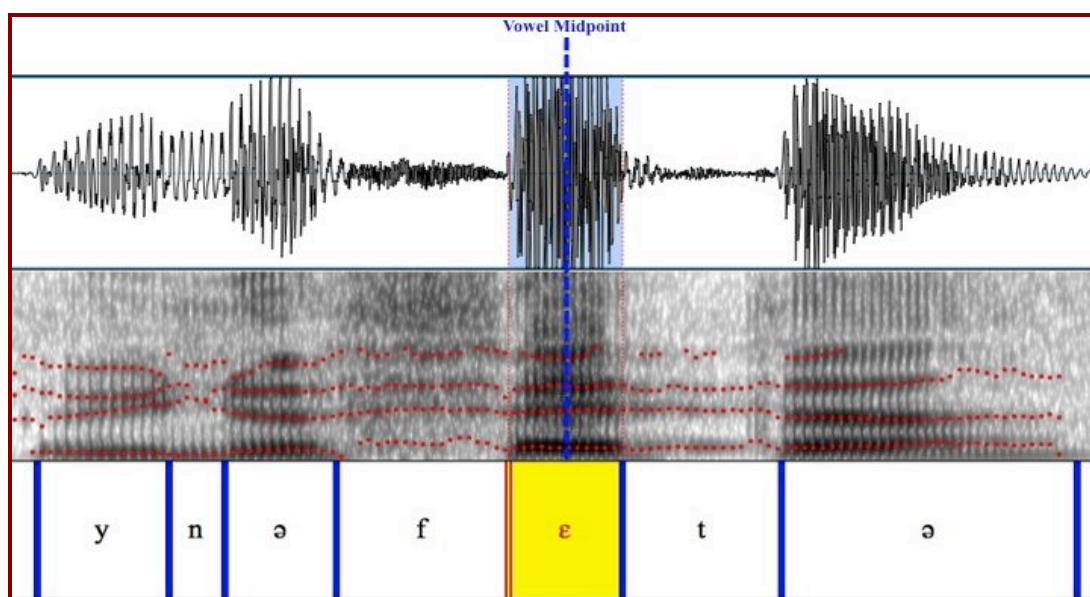


Figure 3.6. Speaker R: spectrogram of the word ‘une fête’ with labels for vowel onset, vowel offset, vowel midpoint and showing LPC formant tracker (F1–F4).

3.3.2.3 NASALISATION

The effect of articulatory gestures associated with nasalisation (such as, for example, velar aperture) on formant frequencies means that measures such as F1 and F2 (for vowels in nasal units) may no longer be wholly accurate correlates of tongue height

and tongue frontness/backness. There is a perceptual confusion between formant changes due to adjustments of the velum and pharynx and formant changes due to lingual configuration. This may result in acoustic characteristics of vowel quality that result from nasal coupling being misperceived as a result of articulatory changes in tongue position. Using real-time MRI data, Carignan et al. (2013) show that there are (at least) four articulatory variables which are predicted to change the F1 frequency of nasalised vowels: velar aperture; tongue height; labial aperture; hypopharyngeal aperture. Both tongue height and hypopharyngeal aperture are shown to be used to enhance the acoustic effects of nasalisation for the nasal vowels. They also show that there are (at least) three articulatory variables which are predicted to change the F2 frequency of nasalised vowels: velar aperture; tongue backness; labial aperture. Nasalised low vowels may manifest low F1 values while nasalised high vowels may manifest high F1 values. Krakow et al. (1988) show this to be due to a combination of jaw placement and nasal coupling. In a similar way, low F2 values for nasalised vowels may indicate tongue retraction but may simply be an acoustic correlate of the percept of nasopharyngeal resonance (Fourakis et al., 2010). The predicted acoustic effects of nasal coupling on the frequency of F1 and F2 can thus be generalized as follows (Carignan et al., 2013): F1 is centralised and F2 is lowered. Finally, de Mareüil et al. (2007) note that F3 is severely affected by nasalisation whereby, due to the presence of nasal anti-formants, F3 can be divided into two peaks of lesser intensity and/or shift towards higher frequencies.

In light of these observations, we must take care when interpreting F1, F2 and F3 values for the vowels in nasal units as the acoustic properties of a given nasalised vowel may not be fully attributable to the articulatory configuration of the tongue's height, its frontness, or lip-rounding, respectively. As with oral vowels, the

traditional articulatory correlates of the formant frequencies measured may only be interpreted approximately due to the effect of other articulatory gestures on formant values. In the acoustic analyses of Béarnais and French, however, nasalised vowels are examined for the same speakers in each language and, since the dimensions of the nasal cavity are fixed for each speaker, the analysis of formant frequencies for each vowel can be seen to compare like with like between, and indeed within, the two languages. Any differences in formant values may, therefore, be attributed to lingual configuration. Extra caution must, however, be exercised when comparing nasalised and non-nasalised vowels for the reasons outlined above.

Degree of nasalisation is notoriously difficult to analyse using instrumental measurement techniques as nasalised vowels often contain extra poles and zeroes (anti-formants), due to the coupling of the nasal and oral cavities, which confuse algorithms such as LPC: ‘an added pole may appear if there is added amplitude on a harmonic that does not conform to the actual formants, while an added zero occurs when the amplitude of a harmonic is damped’ (Di Paolo et al., 2011:94). Nonetheless, Schwartz notes that we can identify important features of nasal spectra: reduction in intensity of the first formant due to the damping characteristics of the nasal cavity walls; the presence of an anti-formant, or anti-resonance, within the vowel spectrum; reinforced harmonics at frequencies where energy is not normally expected due to nasal cavity resonances; a shift in the relative frequency positions of the formants vis-à-vis an oral vowel equivalent due to the coupling of the nasal and oral cavities (1968:135-137). Schwartz also notes that since the larynx functions identically for the production of nasal and oral vowels, the basic difference between them should be investigated in a consideration of contrasting harmonic intensities, rather than different harmonic frequencies, though, as indicated above, nasalisation

may ‘move’ vowels within the acoustic vowel space as the resonant frequencies at which the harmonics are amplified are altered (1968:137).

Overall, there is no reliable instrumental measurement technique for nasalisation and thus, for the reasons outlined in this section, vowels in nasal units were classified simply as ‘nasalised’ or ‘non-nasalised’ using an auditory analysis (see Section 3.3.3.1).

3.3.2.4 INTRA-RATER RELIABILITY

For acoustic-phonetic analyses, intra-rater reliability was tested by recoding a subset of the instrumentally-measured data and examining the mean difference between the two sets of measurements. Reporting both signed and absolute mean differences, as well as their range, between the first and second measurements is the most appropriate demonstration of reliability because using statistical correlation tests may show significant results if large differences are consistently present between the initial data set and the recoded data (Clopper, 2011:191).

Since the measurement of the formant frequencies was performed automatically, testing intra-rater reliability in the Béarnais and French data sets involved measuring the accuracy with which the vowel onset and offset were labelled (since this would, in turn, affect the script’s identification of the vowel’s midpoint). These labels, of course, indicate the vowel’s duration. For each variable included in the acoustic analysis, the data were randomised in order to extract a random subset of tokens (10%) to be recoded. The mean differences between the original data set and the recoded subset (presented in Table 3.8) are all near to zero, indicating that the measurement error is minimal and that the data set is reliably coded. The range of the error for the duration measurements falls within 1-2% (1.3-

2.6ms) of the data set mean and conforms to Allen's (1978) criterion that 2ms should be taken as the limit on measurement error for vowel durations. The data set is therefore reliably coded.

Measure	Mean Signed Difference	Mean Absolute Difference	Range
Duration	0.0138	0.0185	1.7412 ms

Table 3.8. Intra-rater Mean Differences and Range for Vowel Duration.

3.3.2.5 DATA NORMALISATION

This section presents the normalisation procedure applied to both the Béarnais and French data sets before statistical analysis was undertaken.

Different speakers exhibit variation in the formant values they produce for a given phonological vowel because of physiological differences in their vocal tracts. These differences are most notable when comparing speakers of different biological sexes because of the greater size of the male vocal tract and the lower fundamental frequency of the source sound. There exists, however, no constant difference between the varying dimensions of the male and female vocal tracts. In order to account for this sexual dimorphism, for the fact that no two speakers' vocal tracts share the same dimensions and to reliably compare vowel tokens across speakers and sexes, all data were normalised. Normalisation aims to eliminate variation which is caused by anatomical differences while preserving variation that is sociolinguistically significant.

Normalisation procedures are categorised as follows (following Flynn, 2011:3): vowel-intrinsic or extrinsic; formant-intrinsic or extrinsic; speaker-intrinsic or extrinsic. Vowel-intrinsic procedures use information from a single vowel category to normalise a given token while vowel-extrinsic procedures use

information from multiple vowel categories to normalise each token. Similarly, formant-intrinsic methods use information from one formant to normalise a given token. For example, all F1 values are taken into account when normalising a given F1 token. On the other hand, formant-extrinsic procedures use multiple formants (F1, F2, F3, etc.) to normalise a single F1 value. Finally, speaker-intrinsic techniques use information from a single speaker to normalise their formant values, while speaker-extrinsic methods use information from all speakers in the sample population to normalise an individual's vowels. Comparative studies on the reliability of various normalisation techniques have shown that the most reliable procedures are classified as vowel-extrinsic, formant-intrinsic and speaker-intrinsic (Adank et al., 2004; Flynn, 2011). Thus, successful normalisation procedures use multiple vowel values within one formant for an individual speaker to normalise their data set.

The earliest example of a vowel-extrinsic, formant-intrinsic, speaker-intrinsic normalisation procedure was proposed by Lobanov (1971) which expresses values relative to the hypothetical centre of a speaker's vowel space. While many newer normalisation procedures exist, such as the Watt and Fabricius (2002) method and the Nearey (1977) method, I have chosen to use the Lobanov method for the following reasons: Fabricius et al. (2009) showed that Lobanov's method outperformed both the Watt and Fabricius and the Nearey methods to a statistically significant extent; Adank et al. (2004) determined the Lobanov method to be the best for reducing the effect of anatomical variation while maintaining phonological and sociolinguistic variation; Flynn confirmed that 'its existing use in the sociolinguistic world is [...] warranted' (2011:22).

The Lobanov method involves calculating z-scores for individual data points which has the effect of transforming the original distribution to one in which the

mean becomes zero and the standard deviation becomes 1. A z-score quantifies the original value relative to the number of standard deviations that the score is from the mean of the distribution. Z-scores (z) were obtained by first calculating the mean (μ) of F1, F2, and F3 values separately (formant-intrinsic) across vowel types (vowel-extrinsic) for all of an individual speaker's data (speaker-intrinsic). Oral vowels and vowels in nasal units were normalised separately as the analysis assumes them to pertain to different subsystems. The mean value of the relevant formant was then subtracted from each individual token (x) for F1, F2 and F3. The result was then divided by the speaker's standard deviation (σ) of the mean frequency for the relevant formant (procedure described in Chen, 2008:635). The formula for z-score calculation can be summarised as: $z = (x - \mu)/\sigma$. The resultant z-scores are all centred around a mean of (0, 0) for each individual speaker, enabling comparison across speakers as the mean of all of their distributions is the same.

During the normalisation procedure, univariate outliers were detected and removed from the data set. Outliers were identified as tokens with a z-score for F1, F2, or F3 that was less than -2.5 or greater than +2.5. This means that tokens for which the z-score for any formant was greater than two and half standard deviations of the mean ($z > 2.5\sigma$) were excluded. The data were then re-normalised, using the raw F1, F2, and F3 values for the remaining data points.

The Lobanov normalisation method assumes that the limits of each speaker's vowels space, as represented by the extreme F1, F2 and F3 values, are equivalent: the metric therefore maps each speaker's vowel space onto that of the other speakers in the data set. This assumption may be problematic for two reasons: the reference vowels used to represent the limits of the vowel space are taken from natural speech, not realisations of cardinal vowels; the acoustic difference between male and female

speakers' reference vowels may not be a function of anatomical difference. In the latter case, these male-female differences, which may or may not be sociolinguistically meaningful, will be removed by the normalisation metric. This is less problematic for sociophonetic studies, than for acoustic phonetic studies, if the nature of vowel variation is already known.

The analyses presented in this thesis use exclusively normalised data from both Béarnais and French for statistical modelling. The numerous vowel plots presented in Chapter 4 and Chapter 5 are, however, based on non-normalised data from multiple speakers, unless explicitly stated otherwise.

3.3.3 AUDITORY ANALYSIS

The acoustic analysis of the vowels occurring in nasal units, described in Section 3.3.2 above, was supplemented with auditory coding techniques. The use of auditory coding for the nasal units provides information on the degree of nasalisation of the vowel, the presence or absence of a nasal consonant coda, and the place of articulation of the nasal consonant, if present.

3.3.3.1 NASALISATION

The auditory analysis of nasalisation concerned the vocalic element of the five Béarnais nasal units. This analysis was undertaken to examine the usefulness of a binary nasalised versus non-nasalised distinction in explaining the variations observed in vowel quality (determined by the acoustic analysis). An auditory analysis of nasalisation was not possible for the French data set due primarily to constraints of time: there were 4,042 nasal vowel variables, across generations, in the French data set (compared to only 335 tokens for Béarnais).

For Béarnais nasal units, nasalisation was determined for the vowel in each case whether a following nasal consonant was present or not. The presence or absence of nasalisation was treated as a binary variable in Béarnais, as illustrated in Table 3.9. The analysis procedure primarily involved repeated listening to the individual tokens to examine the presence of nasalisation in the vowel quality.

Variable	Variant 1	Variant 2
(Nasalisation)	Nasal/Nasalised	Non-nasalised

Table 3.9. Nasalisation variable and variants (Béarnais vowels in nasal units).

3.3.3.2 NASAL CONSONANT CODAS

The presence of a nasal consonant was examined for all Béarnais nasal units and French nasal vowels. As discussed in Chapter 2, the presence of a nasal consonant coda in Béarnais nasal units is lexically defined and, as such, the auditory analysis merely confirmed the presence of a nasal consonant where it was expected to occur. For French, on the other hand, we saw that the presence of a nasal consonant coda is variable. In both cases, however, the auditory analysis of consonant absence/presence provided a basis on which to split the Béarnais and French data sets according to the phonetic structure of the nasal unit: sequential [ṽN] and non-sequential [ṽ]. The separate examination of vowels in these different phonetic environments was necessary to take account of the potential coarticulatory effect of nasal consonant presence on vowel quality. Since Taylor (1996) has also shown nasal consonant presence to be negatively related to nasalisation (see Section 2.4.2), the presence or absence of a nasal consonant coda may further affect vowel quality due to the effect of related nasopharyngeal coupling on formant frequency values (see Section 3.3.2.3).

The auditory examination noted the presence or absence of a nasal consonant as well as the place of articulation of the nasal consonant when it was present in both Béarnais and French. Table 3.10 illustrates the variants included in each analysis.

Variable	Variant 1	Variant 2	Variant 3	Variant 4	Variant 5
Consonant	Present	Absent			
Quality	[-]	[n]	[m]	[ŋ]	[ɲ]

Table 3.10. Nasal Consonant Variable and Variants (Béarnais and French).

3.3.3.3 INTRA-RATER RELIABILITY

As for the acoustic analysis, a random 10% sample of the data set was recoded auditorily for the Béarnais nasal units and the French nasal vowels. For both the Béarnais and French data sets, the recoded tokens for consonant absence/presence and consonant place of articulation showed no difference from the original auditory analysis: the coding for these variables was 100% reliable. For the ‘nasalisation’ variable, the observed agreement (O) within each nasal unit as well as the error (E) predicted by chance are presented in Table 3.11 for the Béarnais data.

The reliability of the auditory coding was examined for ‘nasalisation’ by calculating a kappa statistic $(O-E)/(1-E)$. The result of the kappa statistic can range from 0 to 1 and values over 0.7 reflect good reliability (Clopper, 2011:190). The kappa statistics for all nasal unit variables are presented in Table 3.12, where they are all shown to be reliable.

Variable	Nasalisation	
/iN/	O	E
	0.94	0.50
/ỹN/	O	E
	0.85	0.50
/ẽN/	O	E
	0.87	0.50
/ãN/	O	E
	0.86	0.50
/ũN/	O	E
	0.92	0.50

Table 3.11. Observed Agreement and Predicted Error for Variable ‘Nasalisation’ (Béarnais Wordlist Data).

Variable	Kappa Statistic	Reliable?
/iN/	0.88	✓
/ỹN/	0.70	✓
/ẽN/	0.74	✓
/ãN/	0.72	✓
/ũN/	0.84	✓

Table 3.12. Kappa Statistics for Nasalisation (by nasal unit) (Béarnais Wordlist Data).

3.3.4 CODING

The coding schemas used for all variables in the language contact and dialect contact studies are included in Appendices 3E–3H. The schemas used for the Béarnais dependent variables are presented first for the mid-vowels and the nasal units followed by the coding schemas used for the (equivalent) French dependent variables. Finally, the coding schemas for the independent variables which apply across all dependent variables are discussed.

Coding schemas for Béarnais variables, used for the ten bilingual speakers in the language contact study are grouped as follows:

- Mid-Vowels (Appendix 3E)
- Nasal Units (Appendix 3F)

French variables were coded for all thirty speakers in the dialect contact study using the following schemas:

- Mid-Vowels (Appendix 3G)
- Nasal Vowels (Appendix 3H)

All variables in the language and dialect contact studies were coded for a series of independent factors, linguistic and extralinguistic, that are hypothesised to constrain the variation under investigation (not included in appendices):

- Linguistic Independent Variables
(Environment, Lexical Frequency)
- Extralinguistic Independent Variables
(Speaker, Age, Sex, Place of Origin)

For each dependent variable in the analysis, the preceding and following phonological and phonetic environments were noted and coded in the token file. These linguistic variables were included to investigate any constraints placed on the variation by its adjacent phonetic and phonological environments and to control for these constraints in the statistical analysis. The four factor groups used are:

- Preceding Phonological Environment
- Preceding Phonetic Environment
- Following Phonological Environment
- Following Phonetic Environment

Tagliamonte notes that it is extremely rare to find a linguistic variable that does not have some kind of lexical conditioning and that it is standard practice to code for lexical identity and lexical frequency to ensure no lexical biases exist in the

data set (2006:121). Word frequency is often found to be a factor causing certain lexical items to be affected by a given change before others. Lexical frequency was coded for each token to explore any effect or constraints on the variation analysed. The lexical frequency measurements were taken from the *Lexique* corpus (New et al., 2001; New et al., 2007), which is based on subtitles in French from 9474 films and TV programmes and contains approximately 50 million words. This corpus was established to remedy the lack of availability of spoken-word-frequency corpora for French and to avoid the problems associated with written word frequencies, which often underestimate the frequency with which certain categories of words are encountered in everyday life (clothing, furniture, casual social interactions, etc.). It aims to approximate the word frequencies encountered in natural spoken language and the constituents of the corpus are as follows (New et al. 2007:662):

- (i) subtitled French films: 1.9 million words (e.g., *Camille Claudel*, *C'est arrivé près de chez vous*);
- (ii) subtitled English and American films: 26.5 million words (e.g., *Arizona Dream*, *Schindler's List*);
- (iii) subtitled English and American television programmes: 19.5 million words (e.g., *Friends*, *Ally Mc Beal*);
- (iv) subtitled non-English-language European films: 2.5 million words (e.g., *Cria Cuervos*, *Good Bye Lenin!*).

The corpus gives equal weight to each of the four subcorpora in order to base frequency estimates on the largest possible corpus and to avoid over-dependence on Anglo-Saxon films. The frequency per million was calculated for each of the subcorpora and the average of these frequencies is presented in *Lexique*.

The *Lexique* corpus contains more ‘modern’ and ‘up-to-date’ vocabulary than traditional sources but diverges negatively from them in two principal ways: there is a bias towards topics, such as police matters and adultery, that occur with high frequency in screen media; there is a subcategory of words that seem to be typically French and that do not figure in many of the films (‘charcutier’, ‘viticole’, ‘viticulture’, etc.) and are thus seriously underestimated in the corpus. However, New et al. (2007) tested the validity of using a subtitle corpus with an experiment requiring subjects to perform a lexical decision task, deciding whether a stimulus was a word or a non-word. The strongest predictor of the reaction times was the word-frequency measures taken from the *Lexique* corpus. Additionally, the subtitled corpus was at least as good as the other lexical frequency corpus tested (DELIC, 2004).

In the present study, the French word was searched in the *Lexique* database and the frequency was recorded in the token file as a continuous variable. *Lexique* distinguishes between morphologically inflected words such as ‘penser’-‘pensons’-‘pensez’ and ‘grand’-‘grande’. It also distinguishes between homonyms where morphological inflection is only indicated in the orthography such as ‘grand’-‘grands’. During coding, words that differ phonetically were counted as different words (e.g., ‘bon’ and ‘bonne’) and were listed separately even though they are forms of the same word from a morphological perspective. Inflected verbs were also listed as separate entries (e.g., ‘chanter’ and ‘chantons’) by the same logic. Homonymic verbal forms in the same tense but different persons (e.g., ‘rentre’, ‘rentrent’) were, however, counted separately in the initial coding phase and verbs in different tenses and belonging to different parts of the verbal system were counted separately (e.g., ‘arriver’, ‘arrivez’, ‘arrivé’), following Hansen (2001:244). Past

participle forms with differential gender (marked in the orthography alone) were counted together (e.g, ‘parti’, ‘partie’). It has been shown that the processing of singular nouns is also influenced by the frequency of its plural (New et al., 2004) and for this reason, I included plural forms in the frequency estimate for singular nouns, with a composite lexical frequency score.

Frequency estimates for the Béarnais data were drawn from the *Lexique* corpus as no corpus exists of written or spoken Béarnais that estimates word frequency. It may be argued that using frequency estimates from French is inappropriate but estimating the frequencies from French is more advantageous than not coding for lexical frequency for Béarnais or trying to estimate lexical frequency from a very small corpus. We must note, however, that due to the diglossic relationship between Béarnais and French, lexical items with local or regional affiliation are likely to have higher frequency estimates than in French.

The analysis also coded for four traditional sociolinguistic variables for all dependent variables: speaker; age (categorical); sex; place of origin. Coding for individual speakers also allows the speaker variable to be included as a ‘random effect’ in mixed-effects statistical models (see Section 3.3.5) which ‘takes into account that some individuals might favour a linguistic outcome while others might disfavour it, over and above (or ‘under and below’) what their gender, age, social class, etc. would predict.’ (Johnson 2009:365).

3.3.5 STATISTICAL ANALYSIS

For both the Béarnais and French mid-vowels and nasal units, the normalised formant frequency data (F1, F2 and F3) were modelled statistically. In each case, the constraints on variation present in each vowel were analysed. Statistical analyses

were also employed to assess the extent to which pairs of vowels (e.g., /ẽ/-/œ/) were distinguished on the basis of vowel height, vowel frontness/backness or lip-rounding (correlated with F1, F2 and F3, respectively).

The statistical modelling technique used in the analysis of continuous variables in this thesis is linear regression. The analysis for the dependent variables was carried out in the R environment (version 2.15.3) using the Rbrul (version 2.06) text-based interface (Johnson, 2008) which makes use of existing functions in the R environment, particularly the model-fitting functions `glm` and `glmer` (Bates and Sarkar, 2008). Rbrul is a variable rule programme which evaluates the effects of multiple language-internal and/or social factors on either a binary linguistic ‘choice’ or, as is the case of most variables in this thesis, on a continuous dependent variable. For the French nasal vowels, the presence or absence of a nasal consonant appendage in the nasal unit was also modelled statistically using a logistic regression analysis for binary categorical variables.

One of the assumptions underlying traditional regression analysis is that the individual observations in the data set are independent of each other (Johnson, 2009:363), or that each individual token is an independent observation. In linguistic data sets, however, tokens are grouped according to the speakers who have produced them: as soon as an individual speaker contributes more than one observation to the data set, they become a source of variation that must be accounted for in the statistical model (Tagliamonte and Baayen, 2012:7). Failure to account for the variation introduced into the data set by individual speakers can lead variable rule programmes to grossly overestimate the significance of extralinguistic effects, outputting statistically significant results that are likely to be due to individual variation combining with chance (Johnson, 2009:363). Additionally, individual

lexical items can potentially favour or disfavour a particular linguistic outcome. It is also necessary to control for this possibility by taking account of variation introduced to the data set by including tokens that have been segmented from a variety of different words. Taking account of variation introduced by differing lexical items leads to more accurate conclusions about internal effects such as phonetic/phonological context or lexical frequency (Johnson, 2009:378).

The specific technique employed for all statistical models in this thesis is a mixed-effects regression analysis. Mixed-effects models make a distinction between two types of factor that can affect a response (dependent) variable. Firstly, fixed effects are factors that are replicable in another study, for example, speaker sex (male/female), stress (tonic/atonic), etc. Random effects, on the other hand, are factors drawn from a larger population which are not completely replicable (Johnson, 2009:365), such as individual speakers and different lexical items. Including a speaker random effect in the regression analysis takes into account that some individuals may favour a given linguistic outcome while others may disfavour it (Johnson, 2009:365). The mixed model will only return a significant result for a given factor, such as speaker sex, if the effect is strong enough to rise above the inter-speaker variation in the model. Likewise, including lexical item as a random effect takes into account the variation introduced into the model by individual words and only returns a significant result for internal independent variables when their effect is large enough to outweigh inter-lexical-item variation. If individual speakers and individual words are not included in the regression model as random effects, the results of the analysis will only be relevant for the individuals and words sampled and p-values may be too small and misleading to generalise to the larger population

(Tagliamonte and Baayen, 2012:7). In all regression models presented in this thesis, ‘speaker’ and ‘word’ are included as random effects.

One of the primary problems with the application of regression analyses to the fixed effect factor groups outlined in the coding schemas was that of collinearity. In both the language contact and dialect contact studies, all vowels (mid- and nasal) were coded for ‘syllable type’, ‘preceding phonetic environment’, ‘following phonetic environment’, ‘preceding phoneme’ and ‘following phoneme’. These factor groups cannot all be included at the same time in a given linear regression model because they are multicollinear. Multicollinearity refers to cases where two or more independent variables are correlated. In the present data set, preceding phonetic environment and preceding phoneme are, of course, highly correlated, though the former contains, necessarily, more categories than the latter. In the same way, following phonetic environment and following phoneme are collinear. There is also a certain amount of multicollinearity introduced into the model by the nature of the wordlist data. Since all speakers are producing the same, or similar, words, the preceding and following phones (and preceding and following phonemes), are largely correlated. For example, there are ten tokens of /e/ in the data set that were segmented from the word *anglés* /angles/ [aŋgles], one token for each older speaker. For these tokens of /e/, the preceding phonetic environment is always [gl], the following phonetic environment is always [s], the preceding phoneme is always /l/, and the following phoneme is always /s/. If the mixed model, for example, were to find a significant effect for following phoneme /s/ on the quality of the /e/ tokens, and a significant effect for the preceding phoneme /l/ on the quality of the

/e/ tokens, it would be unclear which effect was actually significant since the individual preceding and following phonemes co-occur. These factors are not completely collinear since following phoneme /s/ also occurs in words within the data set for which the preceding phoneme is not /l/ but a certain amount of collinearity still exists. Additionally, the ‘syllable type’ factor group is correlated with both ‘following phoneme’ and ‘following phonetic environment’, since for example, final open syllables (/Cv#/) always correspond to a zero value for environment and, for the same reasons outlined above, partial collinearity is introduced by the fact that, for example, medial open syllables (/vCV(C)#/) occur in a limited set of phonetic/phonological environments determined by the restricted range of lexical items included in the wordlist. In any case, interdependencies such as those between independent predictors should never be considered together (Tagliamonte and Baayen, 2012:24-25): unsolvable computational problems often arise resulting in various kinds of error message from the variable rule programme. If the variable rule programme is successful in returning an output for a model containing multicollinear predictors, the coefficient estimates for the linear regression will not be precise because of difficulty experienced in parcelling out the effect of the multicollinear predictors on the response variable. The regression analyses presented in Chapters 4 and 5 include only ‘syllable type’ as a factor group because the methodology used coding schemas that filled cells with tokens occurring in a defined set of syllable types (see Tables 3.6 and 3.7). The number of tokens per cell (or factor) is thus much more evenly distributed for ‘syllable type’ than for the phonetic/phonological context factor groups. This even distribution of tokens across

the cells provides more reliable regression coefficients and makes for a more robust statistical analysis overall.

3.4 CHAPTER SUMMARY

This chapter has presented the methodology employed in two studies which analyse linguistic variation and change in the RF of Béarn.

For the language contact study, speakers were selected at three semi-rural fieldwork sites near Pau using a quota-sampling technique which stratified the sample by biological sex. Informants participated in a sociolinguistic interview in French and performed a wordlist translation task into Béarnais. The French casual speech corpus and the Béarnais translation task corpus provide the raw data set for the study of transfer in the RF of the older, bilingual speakers.

In the dialect contact study, three generations of speakers were selected to participate in sociolinguistic interviews in French: ten bilingual speakers aged 65+, ten middle-aged speakers aged 30-50 years; ten secondary school students aged 16-18 years. The thirty-speaker sample for the dialect contact study was also stratified by biological sex. A large corpus of French casual speech was analysed to investigate the retention or loss of local phonological and phonetic variants in RF over time.

For both the language and the dialect contact studies, variables under examination are analysed using an acoustic phonetic analysis (F1, F2, F3). The acoustic analysis aimed to capture relatively fine-grained phonetic detail in vowel quality using instrumental techniques from laboratory phonetics to analyse variants along a multidimensional continuum. For the Béarnais nasal units, the acoustic analysis was supplemented by an auditory analysis which focused on nasalisation

and, for the French nasal vowels, the presence or absence of a nasal consonant coda was coded auditorily.

The coding schemas for dependent and independent variables applying across studies were presented as well as the statistical modelling techniques involved, highlighting in particular issues of multicollinearity.

CHAPTER 4

THE LANGUAGE CONTACT STUDY

« Quand quelqu'un leur ouvre les yeux, et leur fait remarquer les fautes qu'ils font, ils les reconnaissent avec surprise : ils sont étonnés d'avoir parler ridiculement toute leur vie. Ils sont les premiers à reconnaître la source du mal, *le patois*. »

(Jean Desgrouais, *Les gasconismes corrigés*, 1801)

This chapter presents the results of the language contact study: a systematic analysis of the Béarnais and French mid-vowel and nasal unit systems focusing on data from the oldest (65+) generation of speakers (five male, five female). The mid-vowel system of Béarnais, the speakers' L1, is examined before that of French, the speakers' L2. The nasal unit systems of each language are also presented separately. The analysis of French parallels, as far as possible, that of Béarnais in order to facilitate comparison at a later stage. The analyses presented for each language have the same aims: to describe the properties of the mid-vowel and nasal unit systems including the general position of all vowels within the acoustic space of each language; to model statistically vowel quality; to identify those factors significantly affecting vowel quality as well as the direction and magnitude of their effect; to examine internal constraints on variation in the mid-vowel and nasal unit systems of both Béarnais and French. The final section provides evidence for phonetic and phonological transfer from Béarnais into French in the speech of the older bilingual speakers and examines the applicability of Flege's SLM to the interference observed.

4.1 BÉARNAIS MID-VOWELS

The F1-F2 graphs below represent the Béarnais vowel space in acoustic terms. Various levels of data pooling are applied to the data, beginning with raw tokens and progressing to speaker means, with the aim of describing both intra- and inter-speaker variation. This section begins with a general description of the properties of the mid-vowels in stressed position without taking into account structural constraints on variation, before providing a more detailed examination of the front vowels, /e/ and /ɛ/ (Section 4.1.1), followed by the back vowel, /ɔ/ (Section 4.1.2).

The Béarnais oral vowels, presented in Chapter 2 (Section 2.2.2.1.1), are summarised schematically in Figure 4.1. /y/ has been excluded from these graphical representations because it is distinguished from /i/ by the feature [+round] and labialisation correlates to a low value for F3 which is not represented in the F1-F2 plot, with the two vowels occupying a similar area in the F1-F2 plane.

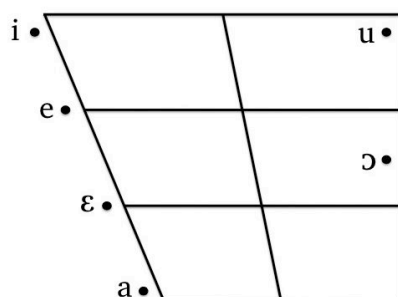


Figure 4.1. Béarnais oral vowels (without /y/)

Token counts are presented in Table 4.1 for male (F-J) and female (A-E) Béarnais speakers for each of the three vowels under investigation. The reference vowels included in the subsequent graphs (/i/ /u/ /a/) are plotted using mean values from approximately 10 tokens per speaker. The differences between speakers in the

number of tokens per cell are a consequence of the data elicitation task where speakers were required to provide a Béarnais translation of a French word: some speakers did not provide a word; some speakers provided a word that was not the target translation and thus did not have the target variable embedded in it. The lower number of tokens for /ɛ/ is a consequence of its lower type frequency in Béarnais.

Sex	Speaker	/e/	/ɛ/	/ɔ/
F	A	20	8	15
	B	18	8	17
	C	21	8	16
	D	17	7	14
	E	14	6	14
M	F	17	7	16
	G	17	8	11
	H	20	7	16
	I	19	7	13
	J	17	7	12
Total		180	73	144

Table 4.1. Token counts for Béarnais mid-vowels by speaker (F = female; M = male).

Non-normalised F1 and F2 values for tokens of the mid- and reference vowels produced by male speakers are presented in Figure 4.2. There is overlap between the mid-vowels and the reference vowels when all speakers' tokens are presented together though the general placement of the vowels conforms to the schematised vowel space in Figure 4.1: two front mid-vowels, /e/ and /ɛ/, occupying the space between the reference vowels /i/ and /a/; one back mid-vowel, /ɔ/, comparable in height to /ɛ/ and located between the reference vowels /u/ and /a/. Mean F1 and F2 values and standard deviations for the individual male speakers

are presented in Figure 4.3³⁶. This figure shows that, for any given speaker, there is no overlap between the mid-vowels and the reference vowels. Speaker J is the only exception to this: the standard deviations of /i/ and /e/ overlap somewhat. The overlap between the mid- and reference vowels observed in Figure 4.2 is thus a consequence of inter-speaker differences present in the non-normalised data set.

Non-normalised F1 and F2 values for tokens of the mid- and reference vowels produced by female speakers are presented in Figure 4.4. Again, we can observe a degree of overlap between the reference vowels and the mid-vowels and the placement of the vowels conforms largely to the schematised vowel space presented above. Figure 4.5 presents the mean F1 and F2 values and standard deviations for vowels produced by female speakers. As was the case for the male speakers, no individual female speakers exhibit overlap between the mid-vowels and the reference vowels. The only exception to this is Speaker B, who shows some overlap between /ɔ/ and /u/. The following sections look at the mid-vowels more closely, considering in detail inter- and intra-speaker variation.

³⁶ For all figures in this chapter presenting data as means and standard deviations, the numerical values for the mid-vowels have been tabulated and may be consulted in Appendix 4A.

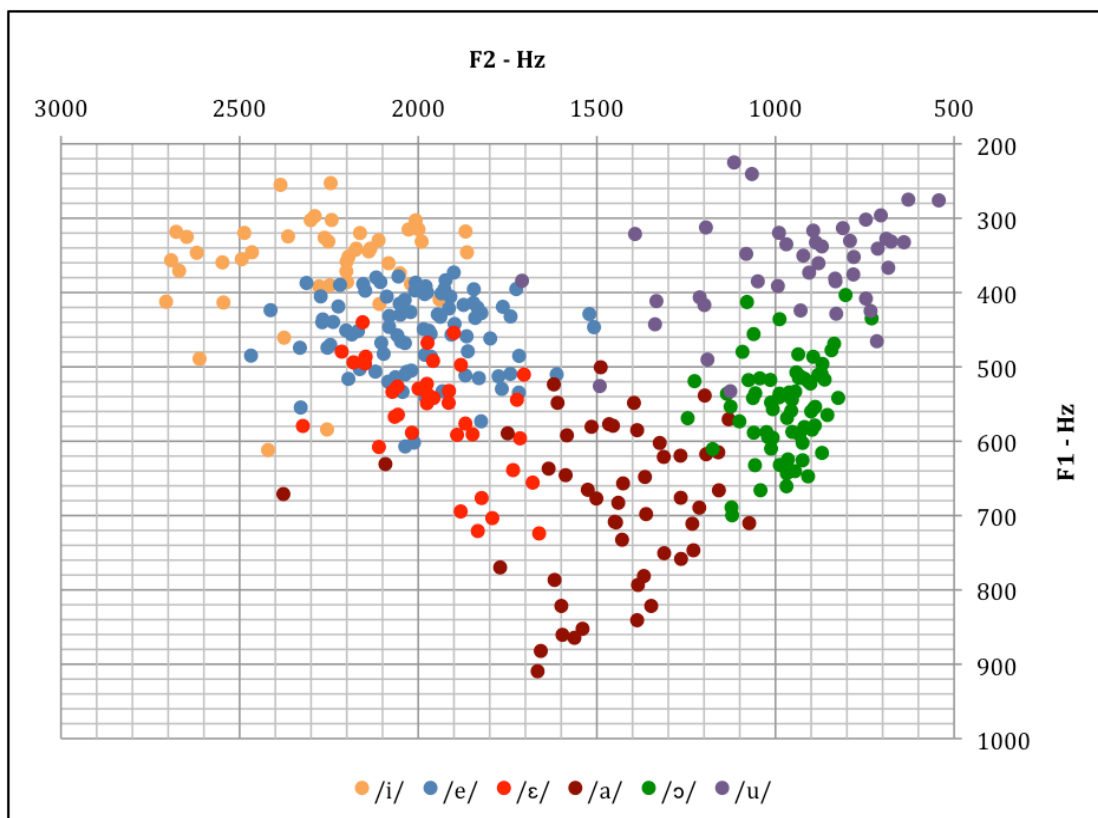


Figure 4.2. Male speakers: F1 and F2 values for Béarnais mid-vowels with reference vowels.

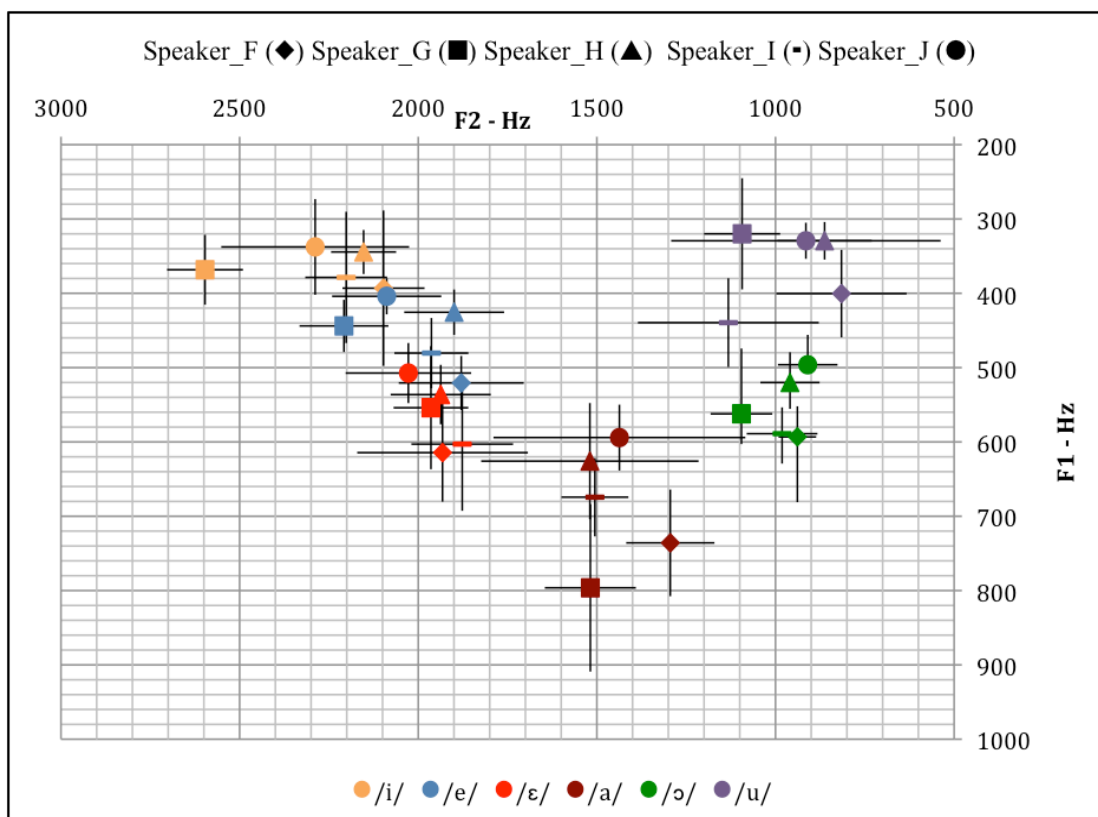


Figure 4.3. Male speakers: Mean F1 and F2 values and standard deviations for Béarnais mid-vowels with reference vowels.

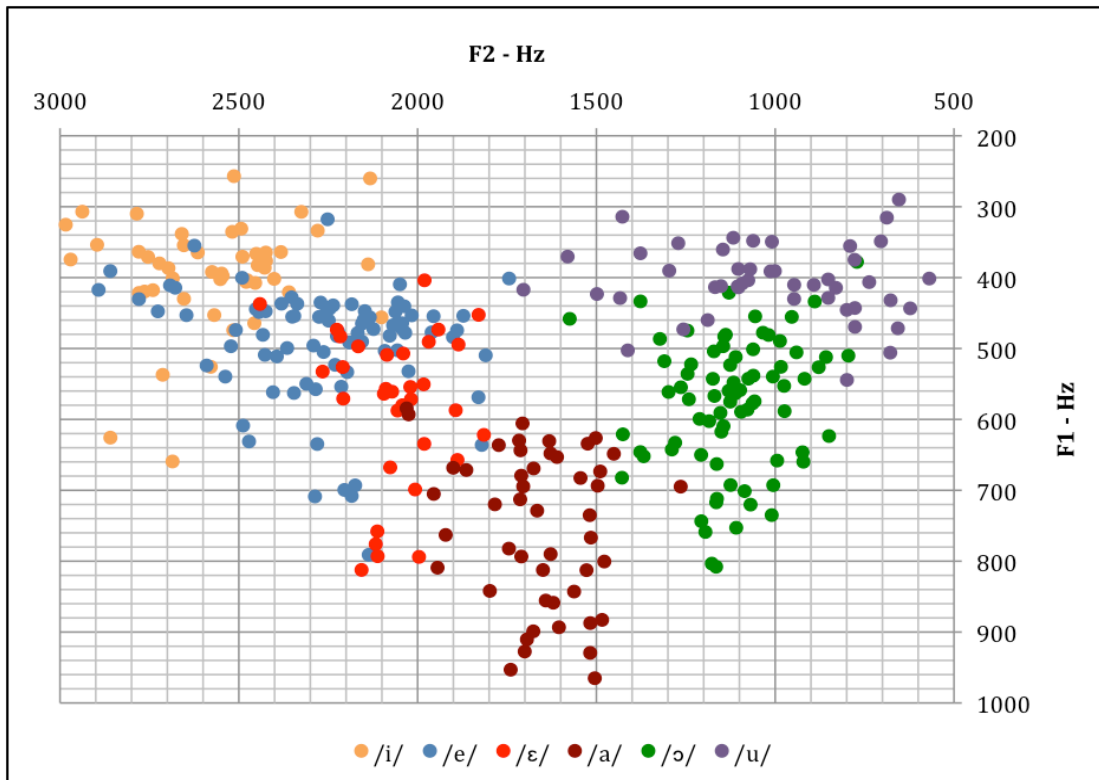


Figure 4.4. Female speakers: F1 and F2 values for Béarnais mid-vowels with reference vowels.

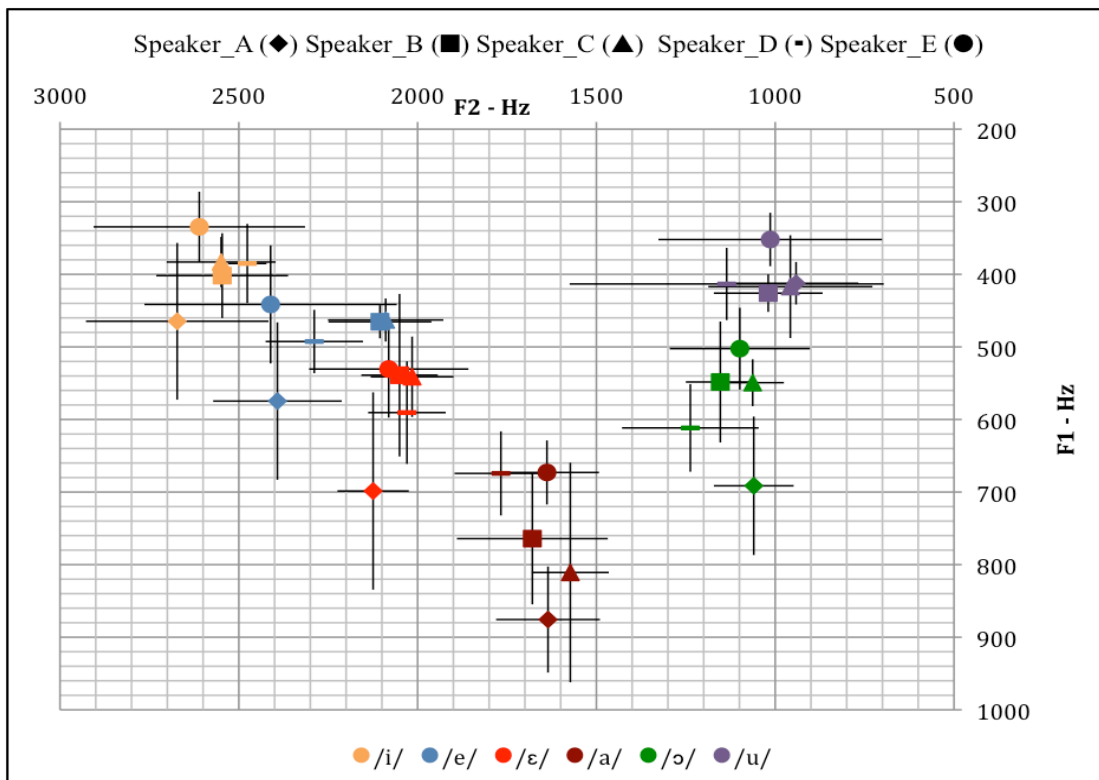


Figure 4.5. Female speakers: Mean F1 and F2 values and standard deviations for Béarnais mid-vowels with reference vowels.

4.1.1 BÉARNAIS FRONT MID-VOWELS

The non-normalised tokens of the male speakers' front mid-vowels are plotted in Figure 4.2. Visually, the phonetic realisations of the front mid-vowels are relatively separate although there is a certain degree of overlap between them. In Figure 4.3, all speakers distinguish between /e/ and /ɛ/ phonetically by producing mean F1 values that are consistently higher for /ɛ/ than for /e/. There is, however, overlap evident between the vowels on the F1 and F2 dimensions for Speakers F and I, and on the F2 dimension alone for Speakers J and H. There is also overlap between Speaker F's mean value for /e/ and Speaker J's mean value for /ɛ/. Speaker G appears different to the other male speakers in that he distinguishes between /e/ and /ɛ/ by making a front/back distinction as well as one of vowel height. The separation between the vowels on the front/back dimension observed for the other male speakers varies across speakers and the standard deviations suggest that there is a lot of overlap on this dimension between /e/ and /ɛ/: F2 is most likely irrelevant for these speakers in making a distinction between the vowels.

The non-normalised tokens of the female speakers' front mid-vowels are plotted in Figure 4.4. There is a tendency for /ɛ/ tokens to be lower than /e/ tokens and overlap is evident on the F1 dimension. Female speakers show a tendency to produce values for /ɛ/ that are more 'back' than for those of /e/, suggesting that they may distinguish between /e/ and /ɛ/ simultaneously on the F1 dimension (vowel height) and on the F2 dimension (vowel frontness/backness). This contrasts with the male speakers' strategy of using primarily vowel height as a method of distinguishing between the front mid-vowels (with the exception of Speaker G). This

‘dual’ strategy employed by female speakers is not so clear-cut, as can be seen in Figure 4.4, where some tokens for /e/ are relatively ‘back’.

For individual female speakers, the tendency for /ɛ/ to be more centralised than /e/ is also evident in Figure 4.5 though the magnitude of the F2 difference between the vowels varies between speakers. The mean values for F2 reveal substantial inter-speaker variability: Speakers A, D and E distinguish between /e/ and /ɛ/ by fronting the former. This is in-keeping with the hypothesis that female speakers are using a dual strategy to distinguish phonetically between the front mid-vowels. On the other hand, Speakers B and C distinguish less between /e/ and /ɛ/ on the F2 dimension suggesting that they distinguish primarily between the vowels on the basis of F1, or vowel height, which was the dominant pattern observed for the male speakers above. All female speakers make less of a distinction between the front mid-vowels than male speakers and have at least minimal backing of /ɛ/ relative to /e/ in the mean values plotted in Figure 4.5.

4.1.1.1 MODELLING THE BÉARNAIS FRONT MID-VOWELS

This section presents the statistical analysis for the Béarnais front mid-vowels focusing on two dependent variables: F1 and F2. The statistical analyses of F1 and F2 include ‘speaker’ and ‘word’ as random effects. All models also include the following fixed effects: ‘phoneme’, ‘syllable type’, ‘lexical frequency’, F1/F2, and ‘speaker sex’ (see Section 3.3.5).

For the front mid-vowels, ‘phoneme’ was included as a fixed effect to examine if the first two formant frequencies could be successfully predicted by the

historically appropriate phoneme (/e/ or /ɛ/) for each token. In the case where ‘phoneme’ cannot predict the vowel quality observed, for example, we can conclude that there is no significant difference between the phonetic realisations of the two phonemes on a given dimension. The formant frequency that is not functioning as the response variable was also included as a factor group in each model. For example, in the analysis of F1, F2 is included as a potential predictor to examine its relationship to the response variable. This decision was taken to investigate articulatory interaction, such as the relationship between fronting/backing (correlated with F2) and raising/lowering (correlated with F1). Within each modelling section, a composite model (including both sexes) is presented first, followed by separate models, if a significant effect for speaker sex is found, for male and female speakers. Table 4.2 presents a summary of the factor groups and factors discussed in the coding section of Chapter 3 (see Section 3.3.4).

Factor Group	Factors	Example
Phoneme	/e/	<i>anglés, yulhét</i>
	/ɛ/	<i>dimers, frinèste</i>
Syllable Type	/Cv#/- Final open stressed	<i>bendoulè,</i>
	/Cv#/- Final open unstressed	<i>atènde,</i>
	/CvC#/- Final closed stressed	<i>her</i>
	/vCV(C)#/- Medial open unstressed	<i>béroye</i>
	/vCV(C)#/- Medial open stressed	<i>tempèste</i>
Lexical Frequency	Continuous variable: logarithmic function of lexical frequency/per million words	-
F1	Continuous variable	-
F2	Continuous variable	-
Speaker sex	Male	-
	Female	-

Table 4.2. Factors groups and factors included in statistical analyses of the mid-vowels.

The regression model for F1 built using the normalised data of both male and female speakers is displayed in Table 4.3. Two fixed factor groups are included as significant predictors of F1 values: ‘phoneme’ ($p \leq 0.01$) and lexical frequency ($p \leq 0.05$). Three factor groups were returned as non-significant: F2, speaker sex and syllable type. There is a highly significant effect of phoneme (/e/ or /ɛ/) on the value of F1. This effect is negative for /e/ (-0.342) and positive for /ɛ/ (+0.342) and the magnitude of the effect is strong. This finding shows that /e/ favours low F1 values while /ɛ/ favours high F1 values: /e/ is realised as a significantly higher vowel than /ɛ/. Secondly, the model shows a negative correlation between lexical frequency and F1. The magnitude of the effect is relatively small and the level of significance is lower than for ‘phoneme’ ($p = 0.0237$). This result indicates that as the frequency of a lexical item increases, the value of F1 decreases (and the vowel is higher).

Dependent variable = F1 N = 253 Grand mean = -0.11		Deviance: 326 Degrees of freedom: 12		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/e/	- 0.342	180	0.000000159
	/ɛ/	+0.342	73	
Lexical Frequency	Continuous (log-transformed)	- 0.14	253	0.0237
Non-significant factor groups were F2 ($p = 0.133$), Speaker sex ($p = 0.247$), and Syllable Type ($p = 0.285$).				

Table 4.3. All speakers: Results of mixed-effects linear regression for F1 in the front mid-vowels.

Table 4.4 presents the regression model for F2, including male and female speakers. All factor groups included are returned as non-significant by the analysis.

‘Speaker sex’ has the lowest level of significance ($p=0.216$) but given the difference in F2 values observed for male and female speakers in the raw and normalised data plots in Section 4.1.1, it is necessary to examine the sexes separately.

Dependent variable = F2 N = 253 Grand mean = 0.677	Deviance: 175 Degrees of freedom: 12
Non-significant factor groups were Syllable Type ($p=0.0908$), Phoneme ($p=0.116$), F1 ($p=0.117$), Lexical frequency ($p=0.197$), and Speaker sex ($p=0.216$).	

Table 4.4. All speakers: Results of mixed-effects linear regression for F2 in the front mid-vowels.

The regression model for F2 for male speakers is provided in Table 4.5. F1 is returned as a significant predictor of F2 ($p \leq 0.05$). The correlation between F2 and F1 is negative: an increase in F1 involves a decrease in F2. This effect is just below the threshold of being ‘highly significant’ and the magnitude of the regression coefficient is relatively low. This means that when male speakers produce lower vowels (with high F1 values), these vowels are significantly centralised (or further back in the vowel space). This result applies to both /e/ and /ɛ/ indicating that tokens of both vowels that are low with also be centralised. Variations in F2, however, are not used by male speakers to distinguish between the vowels: ‘phoneme’ is returned by the analysis as a non-significant predictor of F2 ($p=0.708$).

Dependent variable = F2 N = 126 Grand mean = 0.712		Deviance: 31 Degrees of freedom: 11		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	-0.172	126	0.0102
Non-significant factor groups were Lexical frequency ($p=0.145$), Syllable Type ($p=0.17$), and Phoneme ($p=0.708$).				

Table 4.5. Male speakers: Results of mixed-effects linear regression for F2 in the front mid-vowels.

Table 4.6 presents the regression model for F2 for female speakers. The significant effect for ‘phoneme’ ($p \leq 0.05$) confirms the observation, based on the plotted data in Section 4.1.1, that female speakers distinguish between /e/ and /ɛ/ using variations in F2: /e/ favours higher F2 values while /ɛ/ favours lower F2 values. Therefore, /e/ is distinguished from /ɛ/ by backing/centralisation of the latter. The magnitude of the effect is not large and the significance level ($p = 0.0442$) is not as high as that of F1 ($p = 0.0000218$). This may be because not all female speakers make as consistent an F2 distinction between the vowels.

Dependent variable = F2 N = 127 Grand mean = 0.642		Deviance: 118 Degrees of freedom: 11		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/e/	+0.114	90	0.0442
	/ɛ/	-0.114	37	
Non-significant factor groups were Syllable Type (p=0.121), Lexical frequency (p=0.477), and F1 (p=0.518)				

Table 4.6. Female speakers: Results of mixed-effects linear regression for F2 in the front mid-vowels.

Phoneme is the most robust predictor of vowel height when all speakers are considered together. Increases in lexical frequency were also shown to predict a higher vowel across speakers. Male speakers show a negative correlation between F2 and F1: front mid-vowel tokens that are fronter are concomitantly higher while lower vowels are centralised. It is not clear that this is a manifestation of open-mid /ɛ/ being backed relative to close-mid /e/. Indeed, the raw data and the statistical analysis show that male speakers do not use variations in vowel frontness/backness (F2) to distinguish between the front mid-vowels but rely primarily on variations in

vowel height (F1). Female speakers, on the other hand, make a distinction between /e/ and /ɛ/ using both vowel frontness/backness (F2) and vowel height (F1). This is confirmed by the statistically significant effect of ‘phoneme’ on the F1 and F2 values observed.

Though not explicitly the focus of this analysis, a regression analysis of vowel duration (controlling for ‘speaker’ and ‘word’ and including ‘phoneme’ as a fixed effect factor group) revealed that there is no significant difference between /e/ and /ɛ/ ($p=0.803$): vowel length is not used contrastively for the Béarnais front mid-vowels.

4.1.2 BÉARNAIS BACK MID-VOWEL

Béarnais has one back mid-vowel /ɔ/. The phonetic realisations of the male speakers’ back mid-vowel tokens are plotted in Figure 4.2. Male speakers exhibit a relatively compact arrangement of the back mid-vowel realisations across speakers. The mean F1 and F2 values and standard deviations for the five male speakers are plotted in Figure 4.3, which confirms that the mean values for /ɔ/ are relatively consistent and located in a compact area of the vowel space, even before the data has been normalised. The standard deviations corresponding to the mean F1 and F2 values show similar levels of variability across speakers for both F1 and F2. Speaker G is exceptional in having a standard deviation for the mean F1 value that is over twice that of any of the other speakers. The standard deviations for the mean F2 values are, again, consistent across speakers and, with the exception of Speaker G, there is more variability in vowel frontness/backness than in vowel height.

Figure 4.4 shows clearly that there is more variability present for the female speakers on both the height and frontness dimensions. The mean F1 and F2 values and standard deviations in Figure 4.5 show that the phonetic realisations of /ɔ/ are located in a relatively compact area of the vowel space, with the exception of Speaker A who has a high F1 value, suggesting somewhat more open realisations of /ɔ/. On the F2 dimension, Speakers A, D and E are much more variable than Speakers B and C. Mean values for both F1 and F2 are much more variable between speakers for female than for male speakers, as was evident in the plots of individual tokens (Figures 4.2 and 4.4, respectively). For F1, female speakers are perhaps taking advantage of the fact that there is no phonemic close mid-vowel in the back of the vowel space and increasing variability on the height dimension.

4.1.2.1 MODELLING THE BÉARNAIS BACK MID-VOWEL

This section presents the results of the statistical analysis for F1 and F2 in the back mid-vowel /ɔ/. The factor groups included in the regression analyses are largely the same as those used for the front mid-vowels (see Table 4.2). We may note that ‘phoneme’ is not included in analyses in this section since Béarnais does not contrast two mid-vowels in the back of the vowel space. Additionally, Béarnais /ɔ/ does not occur in the same range of syllable types as the front mid-vowels: the factors within the ‘syllable type’ factor group have thus been modified to reflect these constraints.

The regression model for F1 considering both male and female speakers is presented in Table 4.7 where two predictors are returned as significant. Firstly, there is a highly significant ($p \leq 0.01$) positive correlation between the value of F2 and F1: as F2 increases, F1 also increases. That is, a back vowel realised as more forward, or

centralised, will also be lower in the vowel space. This relationship between centralisation and lowering has also been seen for the front mid-vowels of male speakers (see Table 4.5). Secondly, the effect of ‘syllable type’ on vowel height is highly significant ($p \leq 0.01$). Final closed stressed syllables and medial open stressed syllables favour relatively higher F1 values while medial unstressed syllables (both open and closed) favour low F1 values. This means that stressed syllables contain lower more open back vowels overall than unstressed syllables, which contain closer vowels. Note that the token counts for the unstressed environment here are low indicating, perhaps, unreliable regression coefficients. The height of /ɔ/ in stressed environments is closer to the canonical open-mid vowel [ɔ]. Speaker sex is returned by the regression model as non-significant but the p-value ($p=0.0761$) is not far below the threshold for significant effects. As we shall see, looking at male and female speakers separately reveals different significant predictors of the variation observed for /ɔ/.

Dependent variable = F1 N = 144 Grand mean = 0.397		Deviance: 181 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	+0.53	144	0.00759
Syllable Type	/C v C#/ – stressed	+0.346	97	0.00773
	/v C V(C)#/ –stressed	+0.168	36	
	/v C V(C)#/ –unstressed	-0.181	9	
	/v C CV(C)#/ –unstressed	-0.333	2	
Non-significant factor groups were Speaker sex (p=0.0761), and Lexical frequency (p=0.0928).				

Table 4.7. All speakers: Results of mixed-effects linear regression for F1 in the back mid-vowel.

Table 4.8 presents the regression model for /ɔ/ for male speakers. The expected positive correlation between F2 and F1 is evident but at a lower significance level than when all speakers are considered together. ‘Syllable type’ is not returned by the analysis as significant for male speakers ($p=0.901$). The model contains a significant positive correlation between lexical frequency and F1 ($p=0.0479$): higher frequency lexical items favour lower vowels with a 0.199 unit increase in F1 for every unit increase in lexical frequency. This indicates that higher frequency words contain more open realisations of /ɔ/.

Dependent variable = F1 N = 68 Grand mean = 0.486		Deviance: 40 Degrees of freedom: 8		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.513	68	0.0265
Lexical Frequency	Continuous (log-transformed)	0.199	68	0.0479
Non-significant factor groups were Syllable Type ($p=0.901$)				

Table 4.8. Male speakers: Results of mixed-effects linear regression for F1 in the back mid-vowel.

Just one predictor is returned as highly significant for /ɔ/ for female speakers in Table 4.9. The same pattern for ‘syllable type’, as seen for male and female speakers together, arises: stressed syllables favour lower vowels while unstressed medial syllables favour higher vowels. This illustrates that the significant effects returned in the composite male-female regression models are based on effects that are attributable to male and female speakers considered separately: F2 for males speakers; ‘syllable type’ for female speakers. In addition to this, male speakers show a lexical frequency effect on the height of /ɔ/ when considered separately.

Dependent variable = F1 N = 76 Grand mean = 0.318		Deviance: 111 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable Type	/C v C#/ –stressed	0.492	49	0.000591
	/v C V(C)#/ –stressed	0.139	20	
	/v C CV(C)#/ –unstressed	-0.298	2	
	/v C V(C)#/ –unstressed	-0.332	5	
Non-significant factor groups were F2 (p=0.165), and Lexical frequency (p=0.767)				

Table 4.9. Female speakers: Results of mixed-effects linear regression for F1 in the back mid-vowel.

Table 4.10 provides the regression model for F2 for both male and female speakers. F1 is the only significant predictor: there is a positive correlation between the F2 values observed and F1. While the probability of the effect is highly significant (p=0.00292), the magnitude of the effect is quite small (+0.099). This finding indicates that an increase in F1 will predict a concomitant (small) increase in F2: lowering of /ɔ/ entails centralisation of the vowel. We have witnessed this correlation already when F2 was found to be a significant predictor of F1 (see Table 4.7). ‘Speaker sex’ is returned as non-significant by the regression analysis. The models which considered males and female speakers separately returned only F1 as a significant predictor of F2 for males speakers (p=0.00126), and no significant predictors for female speakers. For male speakers, the significant F1/F2 correlation was positive (as above) but the magnitude of the effect (+0.185) was relatively larger than when both male and female speakers were considered together (+0.099).

Dependent variable = F2 N = 144 Grand mean = -1.114		Deviance: -68 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.099	144	0.00292
Non-significant factor groups were Speaker sex (p=0.074), Lexical frequency (p=0.215), and Syllable Type (p=0.287).				

Table 4.10. All speakers: Results of mixed-effects linear regression for F2 in the back mid-vowel.

In summary, when all speakers are considered together (and when male speakers are considered separately), F2 exhibits a positive correlation with F1: centralisation of the back mid-vowel is accompanied by concomitant lowering. Movement towards the centre of the vowel space is significantly correlated with higher F1 values (lower vowels) in both the front and the back mid-vowels. This correlation can also be seen in the analysis of F2, whereby F1 was found to be a significant predictor of frontness/backness for male speakers and for all speakers considered together. When all speakers are considered together and when female speakers are considered separately, stressed (particularly final) syllables were found to promote lower vowels while unstressed medial syllables favoured higher vowels.

4.2 BÉARNAIS NASAL UNITS

Synchronically, the Béarnais ‘nasal units’, /iN ỹN ěN ãN ũN/, are reflexes of Latin ‘vowel plus nasal consonant’ sequences in closed or late-closed syllables. While the main purpose of this section is to examine vowel quality and the relative position of the vowels in nasal units, the reader is reminded that the nasal units involve complex non-linear interactions between at least three parameters: nasal consonant presence/absence; vowel nasalisation; vowel quality.

The presence of a nasal consonant in the nasal unit is lexically defined for all speakers. For example, *crampe* (‘chambre’) /'krāNpɔ/ is always realised with a nasal consonant ['krāmpɔ], whereas *câ* (‘chien’) /kāN/ is not, [kā]. The analysis of the nasal units undertaken here will examine nasality and vowel quality in each of the lexical sets separately: the sequential lexical set [ṽN] and the non-sequential lexical set [v̄]. The potential effect of consonant presence on nasalisation and on the vowel formant frequencies precludes an analysis which considers the lexical sets together even if the methodology adopted assumes them to realise phonologically the same unit.

Variation in nasalisation is treated impressionistically and based on auditory coding of the vocalic element in the nasal units. We have previously noted that the effect of nasalisation on vowel quality may manifest as acoustic lowering of F2 that does not correspond to articulatory backing (see Section 3.3.2.3). For this reason, the distribution of nasalised and non-nasalised vowel tokens should be taken into account when evaluating both inter-speaker and inter-variable differences: an observed difference in vowel quality (particularly F2) may be related to a greater proportion of nasalised or non-nasalised vowels for a given variable or for a given speaker. The analysis of nasalisation will focus on differential nasalisation between the sequential and non-sequential lexical sets outlined above as well as on the effect of nasalisation on vowel quality. Note that a nasal diacritic is employed in all phonetic transcription used to represent both the nasal units phonologically /iN ỹN ēN āN ũN/ and the sequential [iN ỹN ēN āN ũN] and non-sequential [ĩ ÿ ẽ ă ũ] lexical sets. This nasalisation is variable across the nasal units and the vowels

transcribed as ‘ $\tilde{v}$ ’ may range from non-nasalised vowels, through partially nasalised vowels, to fully nasalised vowels. In the analysis of nasalisation and vowel quality, each of the lexical sets will be represented as ($\tilde{v}$ N) and ($\tilde{v}$) to indicate the variable nature of the vocalic element.

Figure 4.6 presents the vocalic elements which occur in the nasal units: the vowel space is asymmetrical with concentration in the front and high areas of the vowel space. The discussion will examine the quality of vowels in nasal units in acoustic terms focusing on the general position of the vowels within the vowel space, focusing on the first two formant frequencies for all vocalic elements, and on F3 for the vocalic elements in / $\tilde{i}$ N $\tilde{y}$ N $\tilde{u}$ N/ due to lip-rounding contrasts present in the high area of the vowel space.

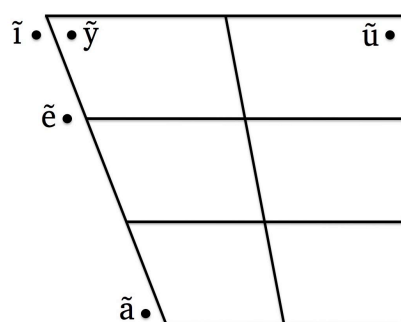


Figure 4.6. Béarnais vowels in nasal units.

After considering each of the parameters outlined above, the final section will model statistically the factors affecting vowel quality in both lexical sets. Table 4.11 presents the token counts included in the analysis of the nasal units. Note that the type frequency of sequential and non-sequential lexical sets varies according to the set’s identity, / $\tilde{i}$ N $\tilde{y}$ N $\tilde{e}$ N $\tilde{a}$ N $\tilde{u}$ N/. This is evident in the low token counts for some units such as, for example, non-sequential / $\tilde{e}$ N/, ($\tilde{e}$).

Sex	Speaker	/iN/		/ỹN/		/ẽN/		/ãN/		/üN/	
		(iN)	(i)	(ỹN)	(ỹ)	(ẽN)	(ẽ)	(ãN)	(ã)	(üN)	(ü)
F	A	6	9	5	9	15	2	9	6	8	8
	B	5	9	7	7	12	2	9	4	8	6
	C	5	10	6	8	10	4	9	5	8	6
	D	5	9	7	6	11	2	9	6	5	7
	E	5	9	6	6	12	2	7	5	8	5
M	F	5	8	6	6	13	2	8	6	7	7
	G	6	9	6	8	12	2	9	6	7	8
	H	5	9	5	7	12	2	7	7	8	7
	I	5	9	6	7	12	2	8	6	8	6
	J	5	9	7	6	14	1	8	5	7	5
Total		52	90	61	70	123	21	83	56	74	65

Table 4.11. Token counts for Béarnais nasal units by speaker (F = female; M = male).

4.2.1 VOWELS IN NASAL UNITS

This section has the aim of addressing the following questions: what effect does nasalisation have on vowel quality (on F1 and F2 values); does nasalisation affect vowel quality differently in the two lexical sets?; is there a correlation between degree of nasalisation and sequential nasal units (where a consonant is present)? All vowels were categorised as nasalised or non-nasalised (see Section 3.3.3.1). For the sequential lexical set (ṽN), two variants are possible [vN] and [ṽN]. Likewise, for the non-sequential lexical set (ṽ), tokens may be realised as [v] or [ṽ] for each of the nasal units. This analysis aims to represent the complex non-linear interactions between vowel quality, nasalisation and consonant absence/presence by examining them together rather than assuming their variability to be independent.

Table 4.12 presents the proportions of nasalised and non-nasalised vowels present in the sequential nasal units for male speakers. For (ỹN), (ãN) and (ũN), a large proportion of vowels are non-nasalised in these units. This applies across speakers and, indeed, some speakers are categorical in their use of non-nasalised vowels for these nasal units such as Speaker J. Nasalisation of the vowel in (ĩN) is variable while there is a tendency for the vowel in (ẽN) to be nasalised.

		(ĩN)		(ỹN)		(ẽN)		(ãN)		(ũN)		Total
		[iN]	[ĩN]	[yN]	[ỹN]	[eN]	[ẽN]	[aN]	[ãN]	[uN]	[ũN]	
F	◆	4	1	5	1	11	2	8	0	6	1	39
G	■	4	2	6	0	10	2	9	0	6	1	40
H	▲	4	0	3	2	10	2	6	1	8	0	36
I	▪	1	4	6	0	9	3	7	1	8	0	39
J	●	0	5	7	0	9	5	8	0	7	0	41
Total		13	12	27	3	49	14	38	2	35	2	195

Table 4.12. Male speakers: Token counts for nasalised and non-nasalised vowels in Béarnais sequential nasal units.

Figure 4.7 presents the F1 and F2 values for all vowels in sequential (ṽN) nasal units for the male speakers. The position of the vowels relative to each other within the vowel space conforms largely to the schema presented in Figure 4.6 above. There is no clear separation, when all speakers are considered together, between nasalised vowels and non-nasalised vowels. For all nasal units, there is visible overlap between non-nasalised vowels and nasalised vowels on both the F1 and F2 dimensions. In the high front area of the vowel space, (ĩN) and (ỹN) tokens are separated on the F2 dimension but are similar with respect to vowel height. The close-mid (ẽN) tokens overlap with both (ĩN) and (ỹN) on both the F1 and F2

dimensions. The (ãN) and (ũN) vowels can be seen to encroach on the back mid-vowel space. They are markedly less separate than /a/ and /u/, presented for male speakers in Figure 4.2. Perhaps this is because, within the nasal unit system, there is no mid-vowel in the back of the vowel space, akin to /ɔ/ for the oral vowels.

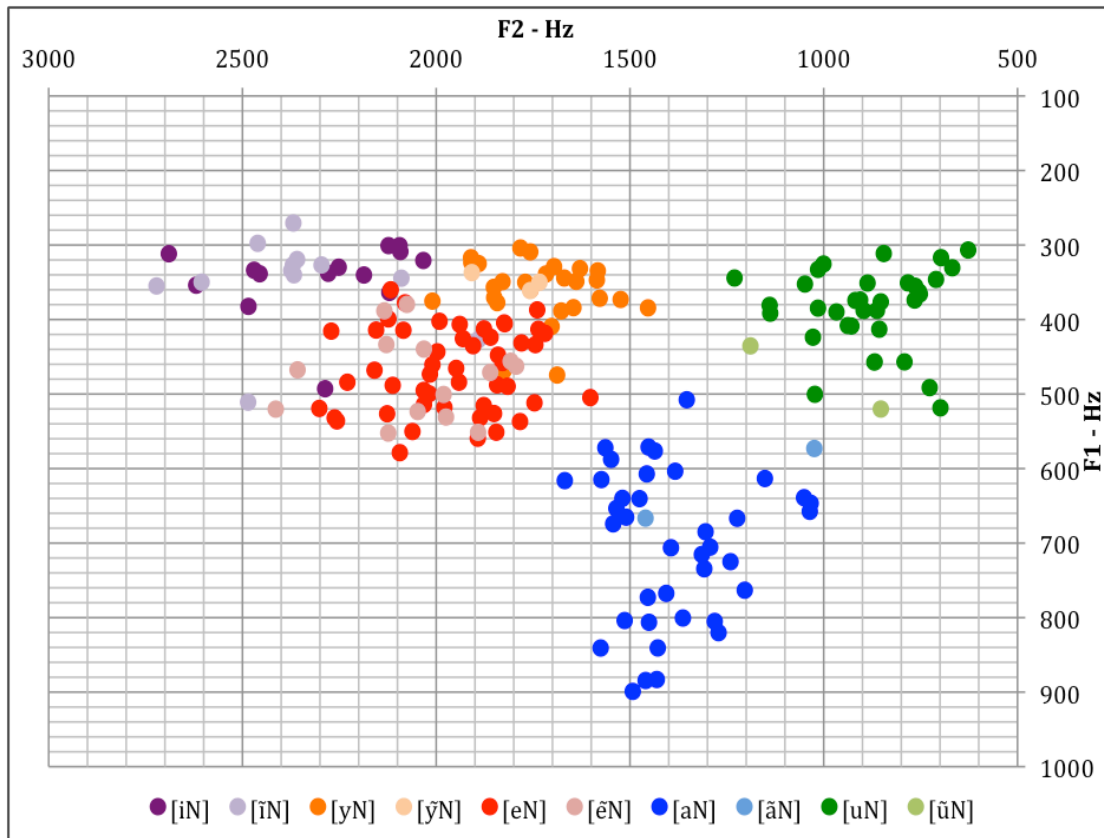


Figure 4.7. Male speakers: F1 and F2 values for Béarnais nasalised and non-nasalised vowels in sequential (ĩN) nasal units.

The mean F1 and F2 values and standard deviations for the nasalised and non-nasalised vowels in sequential nasal units are plotted in Figure 4.8 for individual male speakers. Due to the reduced number of tokens included here and to the categorical non-nasalisation of some vowels by some male speakers, it was not possible to plot means and standard deviations for the non-nasalised and nasalised variants for all speakers. Data points with no standard deviations represent a single token. This reduced number of nasalised tokens in sequential units makes

comparisons with non-nasalised vowels difficult. Comparisons may only reliably be made between nasalised and non-nasalised vowels in the (ēN) nasal unit. All Speakers, except Speaker G, show an overlapping distribution for nasalised and non-nasalised tokens of (ēN) with minimal separation of the means. With the exception of Speaker I, the separation of the means for nasalised and non-nasalised tokens of (ēN) involves a higher F2 value for the nasalised variant. For Speaker G, there is complete separation between [eN] and [ēN] with F2 raising for [ēN]. The effect of nasalisation is not evident for the same speaker for (īN), where the means and standard deviations of the nasalised and non-nasalised variants are overlapping. This raised F2 value for [ēN] is at odds with the findings of Carignan et al. (2013) which showed that nasal coupling lowers F2.

In the aggregate data, presented in Figure 4.7, the (āN) and (ūN) vowels seem to show a lot of variability in the back of the vowel space but when individual speakers are considered separately, as in Figure 4.8, the vowels do not encroach on the mid-vowel space to the same extent: individual speakers maintain clear separation between (āN) and (ūN). One exception to this may be Speaker H whose nasalised (āN) token is located in the mid-vowel space.

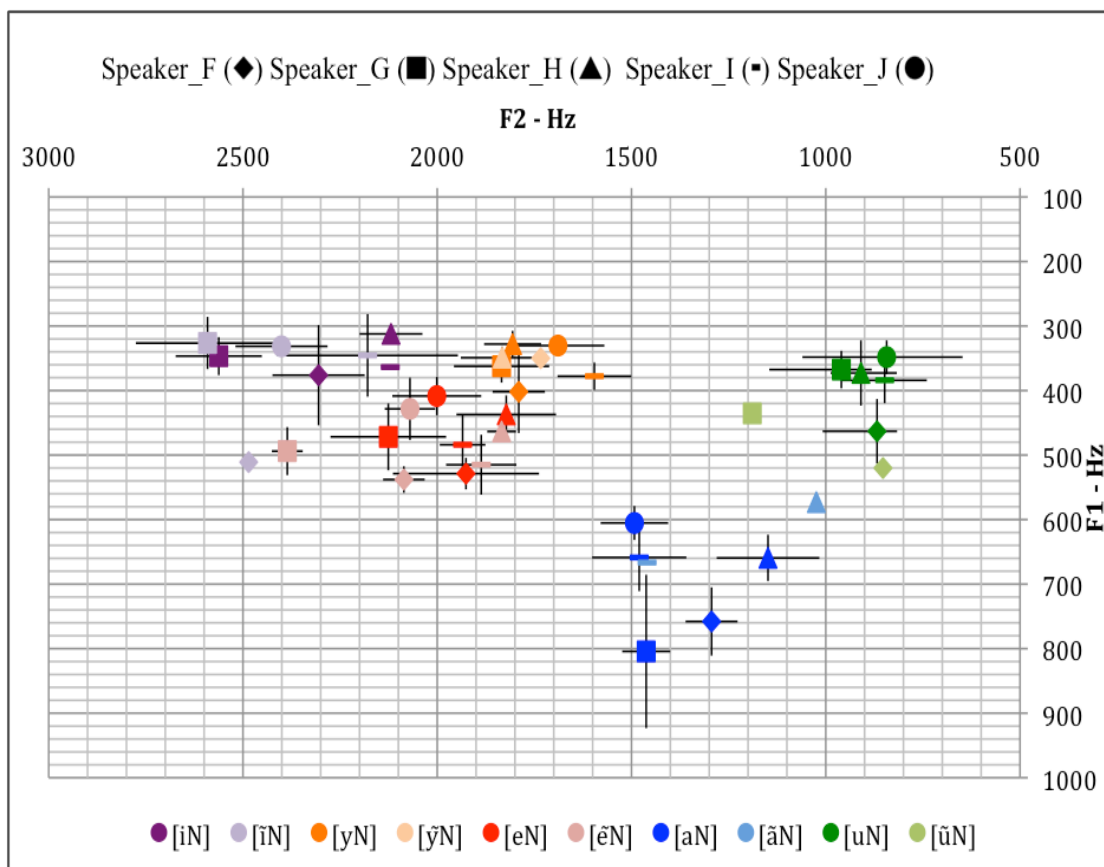


Figure 4.8. Mean speakers: Mean F1 and F2 values and standard deviations for Béarnais nasalised and non-nasalised vowels in sequential ($\tilde{v}N$) nasal units.

Table 4.13 presents the proportions of nasalised and non-nasalised vowels present in the non-sequential ($\tilde{v}$) nasal units. There is a larger proportion of non-nasalised vowels present in the ($\tilde{i}$), ($\tilde{y}$) and ($\tilde{u}$) nasal units than of nasalised vowels. For ($\tilde{a}$) and ($\tilde{e}$), on the other hand, the vowel is more often nasalised. This is not true of ($\tilde{a}$) for Speaker F.

		(i)		(ỹ)		(ẽ)		(ã)		(ũ)		Total
		[i]	[ĩ]	[y]	[ỹ]	[e]	[ẽ]	[a]	[ã]	[u]	[ũ]	
F	◆	8	0	4	2	0	2	5	1	7	0	29
G	■	7	2	8	0	1	1	3	3	6	2	33
H	▲	6	3	3	4	0	2	1	6	6	1	32
I	▪	6	3	4	3	0	2	1	5	6	0	30
J	●	5	4	4	2	0	1	0	5	3	2	26
Total		32	12	23	11	1	8	10	20	28	5	150

Table 4.13. Male speakers: Token counts for nasalised and non-nasalised vowels in Béarnais non-sequential nasal units.

Figure 4.9 presents the vowel tokens in non-sequential nasal units for male speakers. Again, the position of the vowels relative to each other conforms largely to the pattern presented in Figure 4.6. There is also visible overlap between nasalised and non-nasalised tokens for all nasal units. There is only one token of non-nasalised (ẽ), [e]. In the high front area of the vowel space, (i) and (ỹ) are separated on the F2 dimension and (ẽ) shows overlap with both (ĩ) and (ỹ) on both the F1 and F2 dimensions. This is a similar pattern to the one observed above for the sequential nasal units (see Figure 4.7). (ã) and (ũ) do not exhibit as much encroachment on the back mid-vowel space as was evident for the vowels in sequential nasal units.

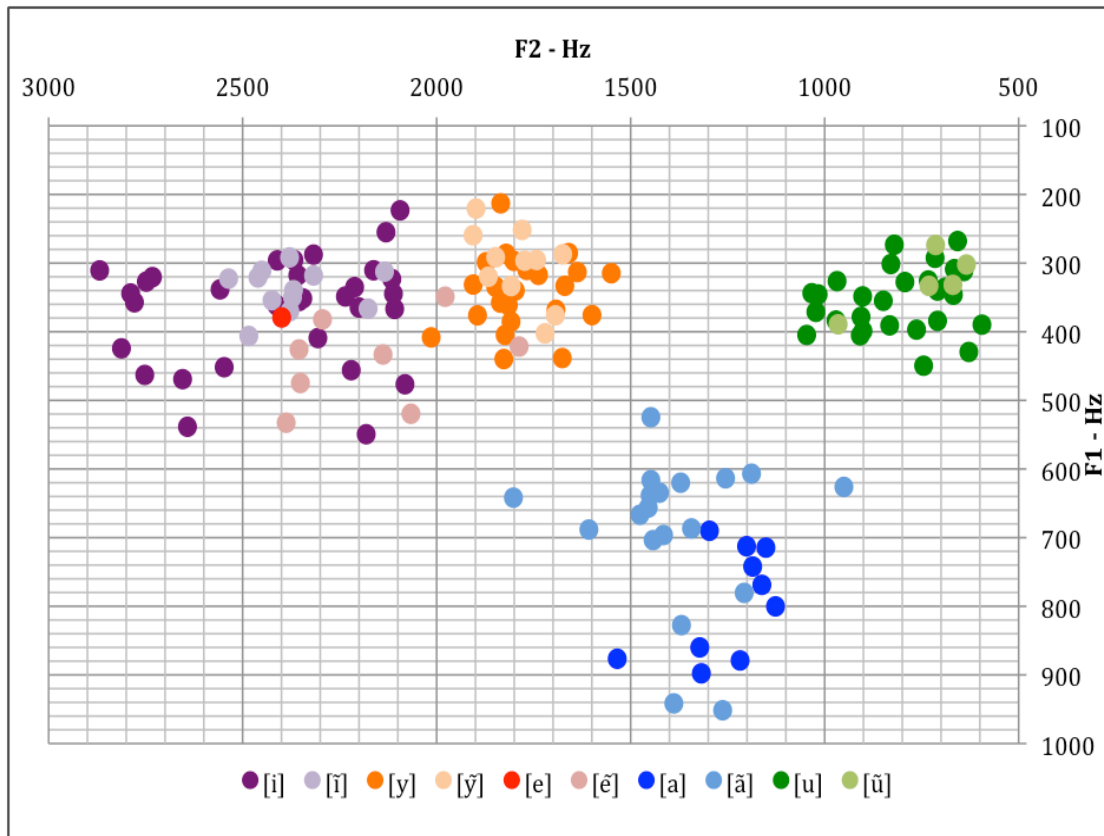


Figure 4.9. Male speakers: F1 and F2 values for Béarnais nasalised and non-nasalised vowels in non-sequential ($\tilde{v}$) nasal units.

The mean F1 and F2 values and standard deviations for the nasalised and non-nasalised vowels in non-sequential nasal units are plotted in Figure 4.10 for individual male speakers. The nasal units (including both nasalised and non-nasalised tokens) are separate from each other for all male speakers. One exception to this is Speaker G, whose token for $[\tilde{e}]$ is very close to the mean value for $[\tilde{i}]$. Four speakers have nasalised and non-nasalised tokens for $(\tilde{a})$, with two speakers demonstrating overlapping nasalised and non-nasalised vowels (Speakers F and G) and two speakers with separation between the variants (Speakers H and I), but the latter have only one token for the non-nasalised variant. The separation between $(\tilde{a})$ and $(\tilde{u})$ can be clearly seen for all speakers. For speakers with nasalised and non-nasalised variants of $(\tilde{u})$, their distributions are overlapping and there is no separation

between the variants, [u] and [ũ]. In the front of the vowel space, the three nasal units are separate for all speakers (with the exception of (ẽ) for Speaker G). With respect to nasalisation, nasalised and non-nasalised variants are overlapping across nasal units and speakers with the following exceptions: Speaker F makes a distinction between [y] and [ỹ] which are separated on the F1 dimension with the nasalised variant exhibiting expected F1 lowering. Speaker G separates the nasalised and non-nasalised variants of (i) with the nasalised variant exhibiting expected F2-lowering relative to the non-nasalised variant. Finally Speaker H has a very low F2 value for the nasalised variant of (ẽ), though this is kept separate from [y] and [ỹ] on the F1 dimension.

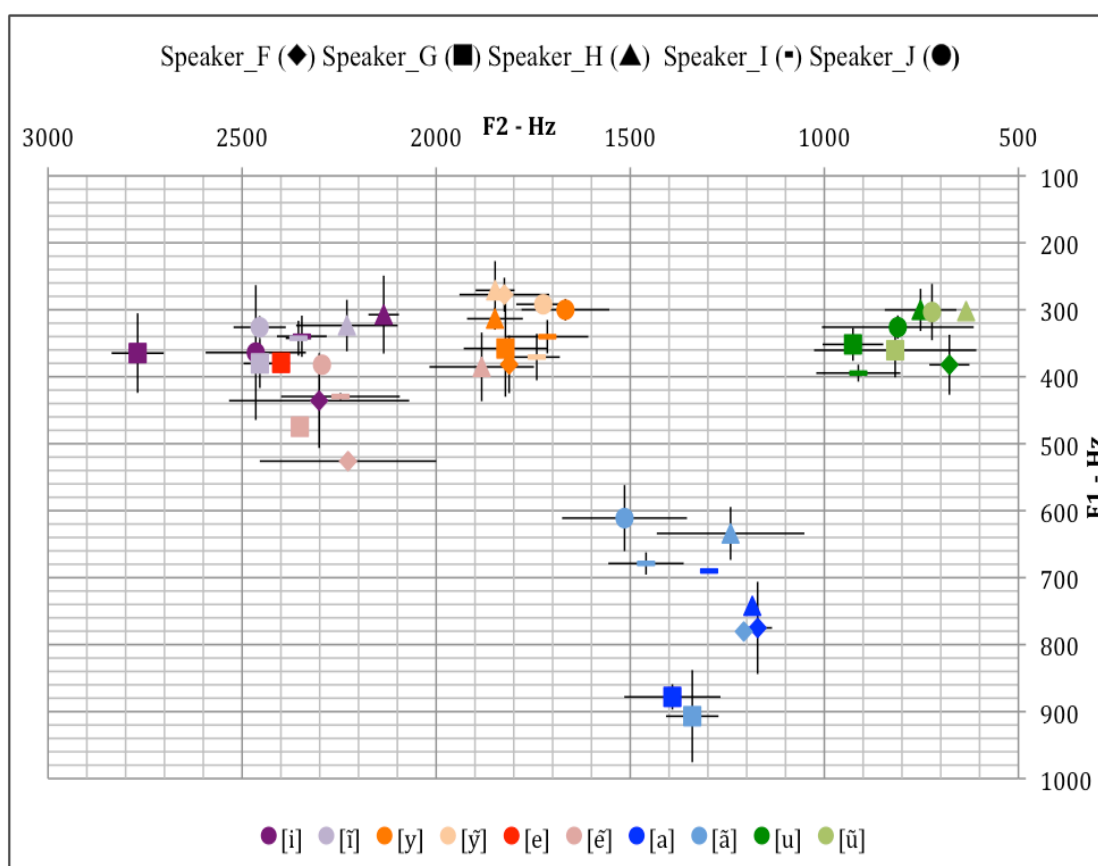


Figure 4.10. Male speakers: Mean F1 and F2 values and standard deviations for Béarnais nasalised and non-nasalised vowels in non-sequential (ṽ) nasal units.

Table 4.14 presents the proportions of nasalised and non-nasalised vowels present in the sequential nasal units for female speakers. Overall there are equivalent numbers of nasalised and non-nasalised vowels in (ĩN) but for all other units, the large majority of tokens in sequential nasal units are non-nasalised.

		(ĩN)		(ỹN)		(ẽN)		(ãN)		(ũN)		Total
		[iN]	[ĩN]	[yN]	[ỹN]	[eN]	[ẽN]	[aN]	[ãN]	[uN]	[ũN]	
A	◆	2	4	4	1	14	1	8	1	7	1	43
B	■	2	3	6	1	11	1	6	3	6	2	41
C	▲	2	3	4	2	9	1	9	0	8	0	38
D	-	2	3	6	1	9	2	9	0	5	0	37
E	●	4	1	6	0	8	4	7	0	8	0	38
Total		12	14	26	5	51	9	39	4	34	3	195

Table 4.14. Female speakers: Token counts for nasalised and non-nasalised vowels in Béarnais sequential nasal units.

The F1 and F2 values for all vowels produced in sequential nasal units by female speakers are plotted in Figure 4.11. The general position of the vowels relative to each other is as expected. With the exception of one nasalised token of (ũN), there is no encroachment of (ãN) or (ũN) on the back mid-vowel space as was the case for the male speakers' sequential units (see Figure 4.7). As for male speakers, there is overlap evident between nasalised and non-nasalised vowels across the nasal units. There are high levels of overlap present in the high front area of the vowel space between (ĩN), (ỹN), and (ẽN). The overlapping tokens are both nasalised and non-nasalised for each of the three nasal units. As with males speakers, there are a reduced number of nasalised tokens, primarily for (ãN) and (ũN).

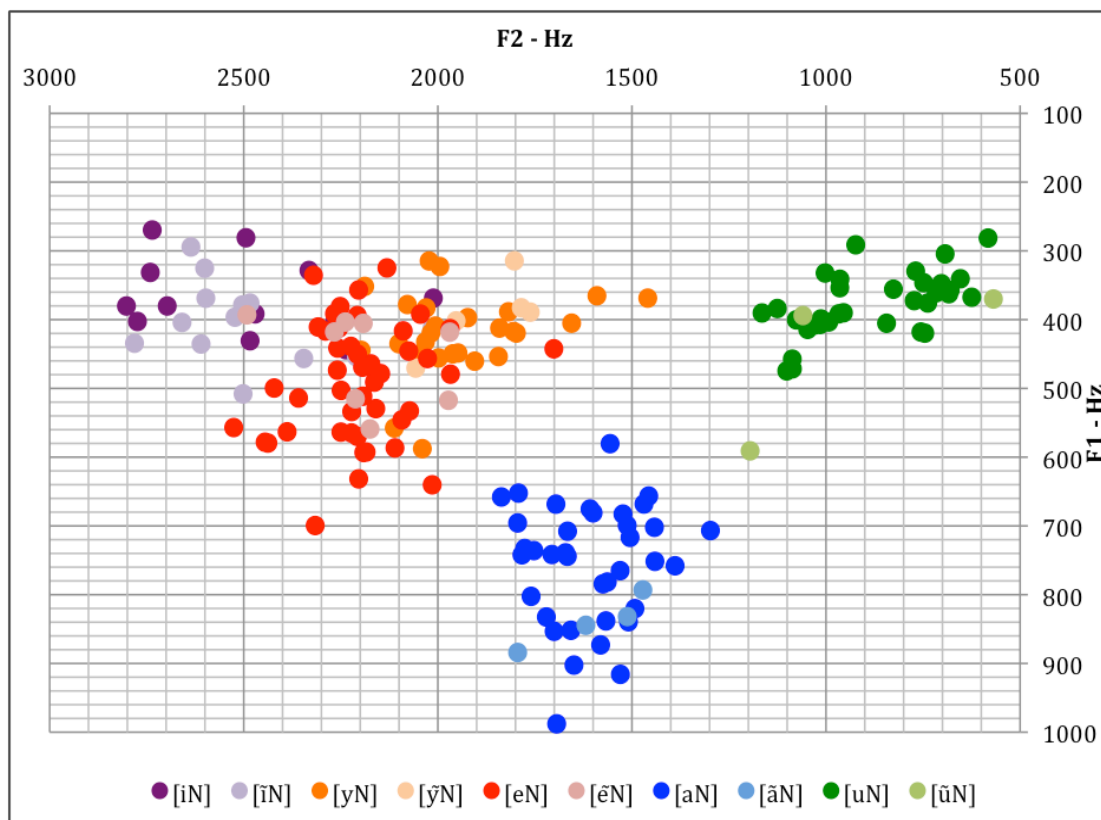


Figure 4.11. Female speakers: F1 and F2 values for Béarnais nasalised and non-nasalised vowels in sequential ($\tilde{v}$ N) nasal units.

The mean F1 and F2 values and standard deviations for the nasalised and non-nasalised vowels in sequential nasal units are plotted in Figure 4.12 for individual female speakers. In the high front area of the vowel space, varying levels of overlap are evident across speakers for ($\tilde{i}$ N), ($\tilde{y}$ N), and ($\tilde{e}$ N). Speaker A is the only female speaker for whom there is complete separation between the vowels in these units. There is F2 overlap between ($\tilde{i}$ N) and ($\tilde{e}$ N) for Speaker A but the vowels are distinguished on the F1 dimension. For Speaker B, there is a high level of overlap between the three nasal units: ($\tilde{i}$ N) is separate from ($\tilde{y}$ N) and ($\tilde{e}$ N) on the F2 dimension but there is overlap evident between the ($\tilde{y}$ N) and ($\tilde{e}$ N) on both the F1 and F2 dimensions. Speaker C distinguishes ($\tilde{e}$ N) from ($\tilde{i}$ N) and ($\tilde{y}$ N) on the F1 dimension but exhibits overlap between non-nasalised [$\tilde{i}$ N] and nasalised [$\tilde{y}$ N]. For

(iN) and (ỹN), there is separation between nasalised and non-nasalised tokens for Speaker C with the former exhibiting higher values for F2. For Speaker D and Speaker E, there is F1 and F2 overlap evident for all vowels in the high front area but the placement of the mean values conforms to the general schema. In the back of the vowel space, the separation between (ãN) and (ũN) is evident across speakers (with the exception of Speaker E's single [ũN] token).

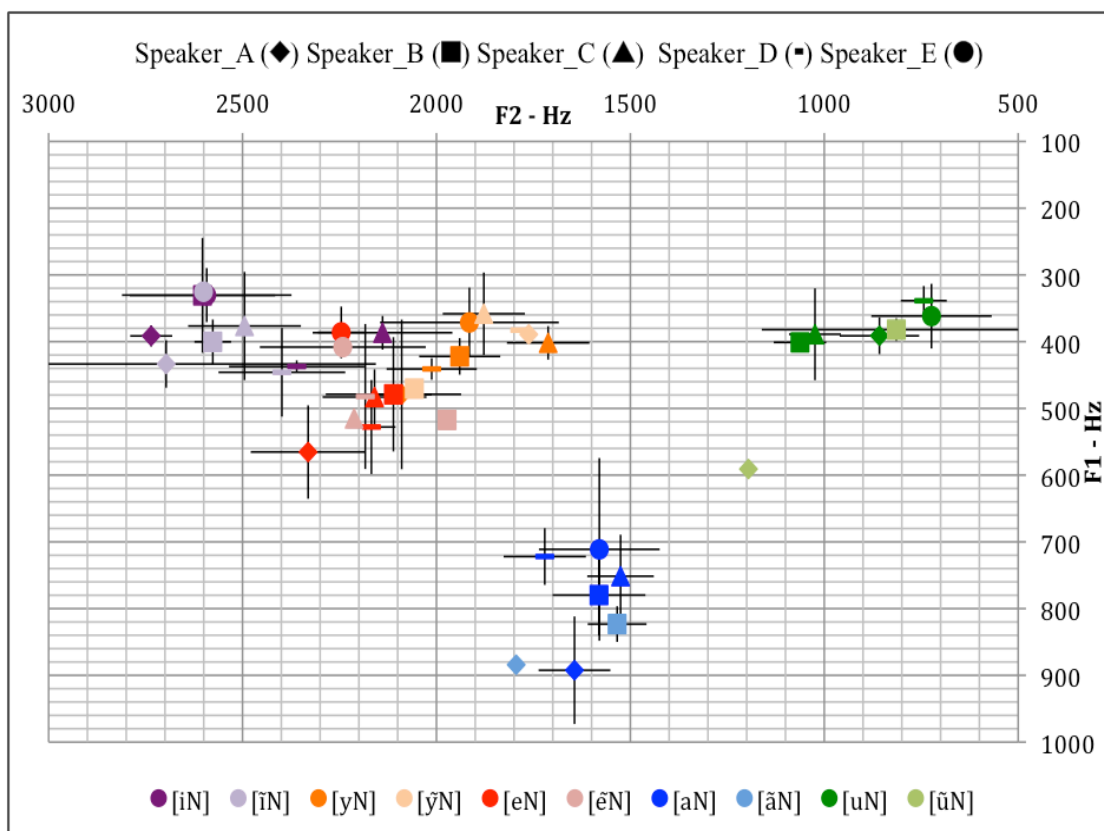


Figure 4.12. Female speakers: Mean F1 and F2 values and standard deviations for Béarnais nasalised and non-nasalised vowels in sequential (ĩN) nasal units.

Table 4.15 presents the proportions of nasalised and non-nasalised vowels present in the non-sequential nasal units. Vowels in (ĩ) nasal units are almost all nasalised whereas the majority of vowels in the (ỹ) and (ũ) nasal units are non-nasalised. The (ẽ) and (ã) vowels have the same or similar amounts of nasalised and

non-nasalised tokens. These proportions of nasalisation differ from the proportions presented for female speakers' sequential nasal units (Table 4.14) and from male speakers' non-sequential nasal units (Table 4.13). Female speakers exhibit a higher proportion of nasalised tokens for (i), (ē) and (ā) than for (iN), (ēN) and (āN). Comparing the non-sequential nasal units of male and female speakers, female speakers also produce more nasalised tokens of (i), (ē) and (ā) than male speakers.

		(i)		(ỹ)		(ē)		(ā)		(ū)		Total
		[i]	[ĩ]	[y]	[ỹ]	[e]	[ē]	[a]	[ā]	[u]	[ū]	
A	◆	0	7	4	5	0	2	0	6	6	2	32
B	■	0	7	3	4	1	1	3	1	6	0	26
C	▲	0	8	8	0	4	0	4	1	5	1	31
D	▪	0	9	4	2	0	2	4	2	5	2	30
E	●	1	2	6	0	0	2	2	3	3	2	21
Total		1	33	25	11	5	7	13	13	25	7	140

Table 4.15. Female speakers: Token counts for nasalised and non-nasalised vowels in Béarnais non-sequential nasal units.

Figure 4.13 presents the vowel tokens in non-sequential (ṽ) nasal units for female speakers. There are some differences between the position of the vowels relative to each other in the non-sequential nasal units when compared with the sequential nasal units (Figure 4.12). There are a reduced number of tokens for (ē) relative to the other non-sequential nasal units and to the sequential nasal unit (ēN). There is also overlap present between nasalised and non-nasalised vowels across the five nasal units. Compared to the sequential nasal units, there are more tokens of (ā) that encroach on the back mid-vowel space with less separation overall between (ā)

and (ũ). In the high front area of the vowel space, again we can see overlap between (i), (ĩ), and (ẽ) on both the F1 and F2 dimensions.

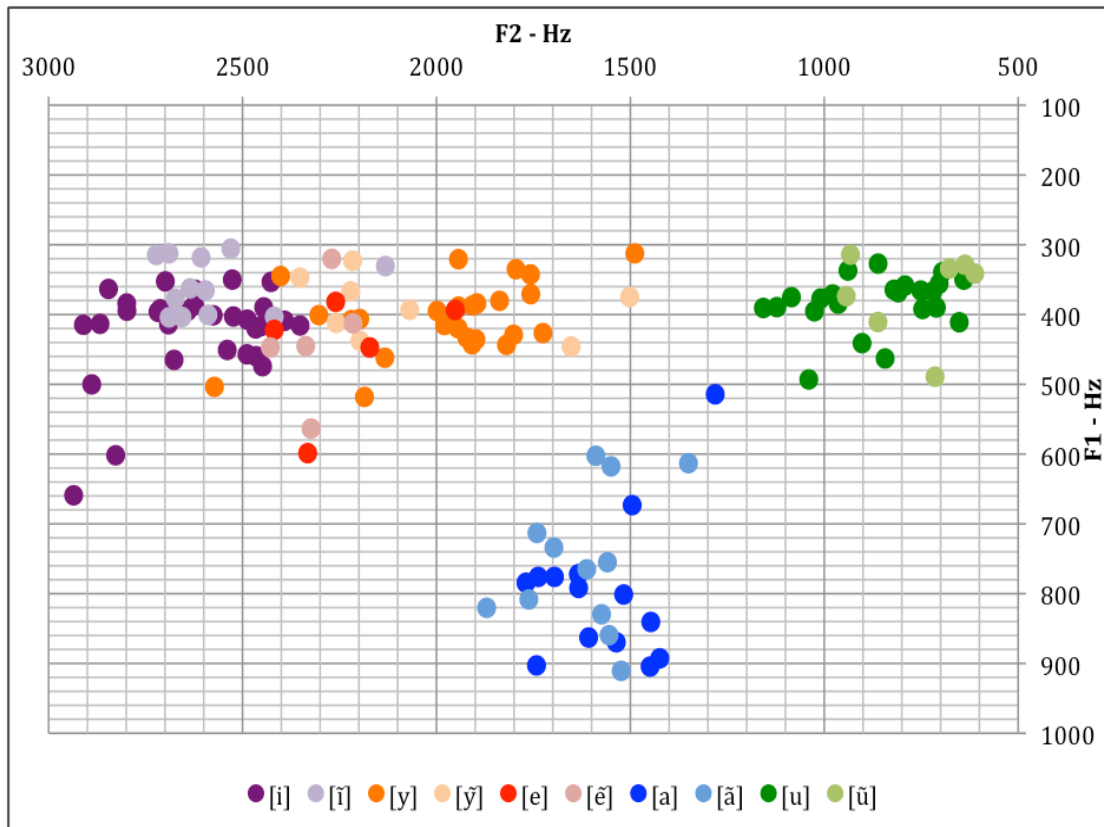


Figure 4.13. Female speakers: F1 and F2 values for Béarnais nasalised and non-nasalised vowels in non-sequential (ṽ) nasal units.

The mean F1 and F2 values and standard deviations for the nasalised and non-nasalised vowels in non-sequential nasal units are plotted in Figure 4.14 for individual female speakers. When individual speakers are considered separately, it is clear that (ã) and (ũ) are completely separate. There is no clear separation across speakers between tokens of [a] and [ã], or [u] and [ũ]. Speaker E, however, shows separation between the variants of both vowels: nasalised [ã] is lower and fronter than non-nasalised [a]; nasalised [ũ] is higher and backer than non-nasalised [u]. In the high front area of the vowel space, individual speakers have different levels of separation between the three nasal units and varying separation between nasalised

and non-nasalised variants of the vowels. Speaker A maintains separation between (i), (ỹ), and (ẽ), with (i) and (ỹ) distinguished in terms of vowel frontness and (ẽ) distinguished from both of these vowels by vowel height. Speaker B and Speaker C also show complete separation between the vowels. Speaker D on the other hand exhibits overlap on the F2 dimension between [i] and [ẽ]. Speaker E has separate distributions for (i) and (ỹ), but the mean value for nasalised (ẽ) overlaps with both (i) and (ỹ) on the F1 dimension. Overall, female speakers do not show a substantial quality difference between nasalised and non-nasalised vowels with the following exceptions: Speaker A has near-separate distributions for nasalised and non-nasalised variants of (ỹ), with nasalised variants having expected lower F1 values; Speaker B's nasalised and non-nasalised variants of (ẽ) are separate but the data points constitute only one token each.

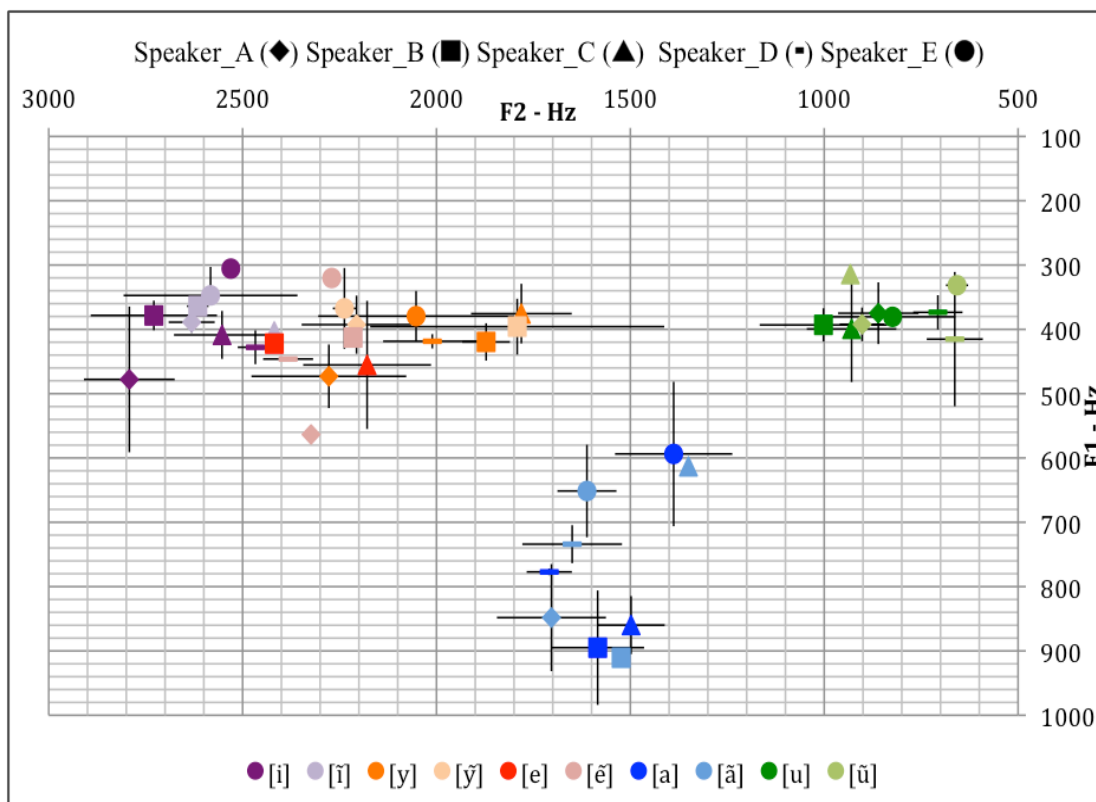


Figure 4.14. Female speakers: Mean F1 and F2 values and standard deviations for Béarnais nasalised and non-nasalised vowels in non-sequential ($\tilde{v}$) nasal units.

4.2.1.1 MODELLING SEQUENTIAL NASAL UNITS

This section presents the statistical analysis of the Béarnais vowels in sequential nasal units using mixed-effects linear regression models. Vowel quality is modelled separately for F1 and F2 and the effect of nasalisation on vowel quality is examined. The separation and overlap between the high front vowels in the / $\tilde{i}N$ $\tilde{y}N$ $\tilde{e}N$ / nasal units are modelled statistically on both the F1 and F2 dimensions.

The independent variables and variants used in the statistical analysis of individual vowels in sequential nasal units are summarised in Table 4.16. Nasalisation is included in each of the models to examine the significance of variations in vowel quality observed in the descriptive data in Section 4.2.1 above.

Factor Group	Factors
Nasalisation	Non-nasalisated
	Nasalisated
Syllable Type	/Cṽ#/- Open final stressed
	/CṽC#/- Closed final stressed
	/ṽCV(C)#/- Open medial unstressed
	/ṽCV(C)#/- Open medial stressed
Lexical Frequency	Continuous variable: logarithmic function of lexical frequency/per million words
F1	Continuous variable
F2	Continuous variable
Speaker sex	Male
	Female

Table 4.16. Factors groups and factors included in statistical analyses of the nasal units (F1, F2).

The regression models presented in this section consider normalised data from male and female speakers together in the first instance but statistical models are separated by speaker sex when there is a significant effect for biological sex in the composite model. ‘Speaker’ and ‘word’ are included in all models as random effects.

The results of the regression analyses for F1 and F2 for the sequential unit (iN) are presented in Tables 4.17 and 4.18 respectively. In each case, the mixed-effects modelling process returned all predictors as non-significant: nasalisation, syllable type, lexical frequency, and F2. The non-significant effect for nasalisation confirms that speakers do not produce substantially different F1 and F2 values for nasalised and non-nasalised variants of (iN). The expected F2-lowering and F1-centralisation, as a result of nasopharyngeal coupling, is not evident in the data.

Nasal Unit = (iN) Dependent variable = F1 N = 52 Grand mean = -0.802	Deviance: 17 Degrees of freedom: 10
Non-significant factor groups were Nasalisation (p=0.06), Speaker sex (p=0.35), Syllable type (p=0.353), Lexical frequency (p=0.398), and F2 (p=0.934).	

Table 4.17. All speakers: Results of mixed-effects linear regression for F1 in (iN).

Nasal Unit = (iN) Dependent variable = F2 N = 52 Grand mean = 1.158	Deviance: 28 Degrees of freedom: 10
Non-significant factor groups were Lexical frequency (p=0.288), F1 (p=0.328), Nasalisation (p=0.513), Speaker sex (p=0.707), and Syllable type (p=0.795).	

Table 4.18. All speakers: Results of mixed-effects linear regression for F2 in (iN).

Table 4.19 provides the results of the regression model for F1 in (ȳN), considering male and female speakers together. Two predictors are returned as significant, speaker sex ($p \leq 0.01$) and nasalisation ($p \leq 0.05$) while syllable type, F2 and lexical frequency do not reach the level of significance. For speaker sex, there is a positive correlation between being female and F1 (+0.099): female speakers have lower vowels than male speakers in (ȳN). While the magnitude of this effect is small (± 0.099), the significance level is far below the threshold for ‘highly significant’ suggesting that the probability of observing this result by chance alone is minute. It is thus necessary to examine regression models for F1 in (ȳN) for male and female speakers separately. The significant effect for nasalisation in the composite model shows that non-nasalised vowels favour higher F1 values while nasalised vowels favour lower values for F1. The magnitude of this effect is relatively large and the correlation is significant at the lower ($p \leq 0.05$) significance level. Nasalised vowels therefore have significantly lower F1 values for (ȳN) than non-nasalised vowels: nasalised vowels are higher in the acoustic vowel space than non-nasalised vowels.

This result makes sense phonetically given that we know nasalisation often has the effect of lowering F1 (for high vowels).

Nasal Unit = (ȳN)		Deviance: 7		
Dependent variable = F1		Degrees of freedom: 10		
N = 61				
Grand mean = -0.526				
Factor Group	Factor	Coeff.	N	P-value
Speaker sex	Female	0.099	31	0.00488
	Male	-0.099	30	
Nasalisation	Non-nasalised	0.105	53	0.0399
	Nasalised	-0.105	8	
Non-significant factor groups were Syllable type (p=0.0762), F2 (p=0.418), and Lexical frequency (p=0.59).				

Table 4.19. All speakers: Results of mixed-effects linear regression for F1 in ($\tilde{y}$ N).

The regression model for male speakers is presented in Table 4.20 where no predictors are returned as significant. For female speakers, the regression model for F1 in ($\tilde{y}$ N) is presented in Table 4.21. Nasalisation and syllable type are returned as significant effects while lexical frequency and F2 are non-significant. The same correlation exists between nasalisation and F1: non-nasalised vowels favour high F1 values while nasalised vowels favour lower F1 values. In other words, non-nasalised vowels are lower in the vowel space than nasalised vowels. The magnitude of this effect is much larger when female speakers are considered separately (± 0.213) and the level of significance is stronger than in the composite model ($p \leq 0.01$). Syllable type is also returned as a significant effect when female speakers are considered separately: medial open syllables favour high F1 values while final syllables (open and closed) favour lower F1 values. Therefore, medial syllables contain lower vowels than final syllables for ($\tilde{y}$ N). The magnitude of this effect is large ($+0.279$ to -0.149) and the p-value is substantially below the threshold for high significance.

The statistical analysis also revealed there to be no significant interaction between nasalisation and syllable type for (ȳN).

Nasal Unit = (ȳN) Dependent variable = F1 N = 30 Grand mean = -0.623	Deviance: -10 Degrees of freedom: 9
Non-significant factor groups were Syllable type (p=0.566), Lexical frequency (p=0.64), F2 (p=0.696), and Nasalisation (p=0.821).	

Table 4.20. Male speakers: Results of mixed-effects linear regression for F1 in (ȳN).

Nasal Unit = (ȳN) Dependent variable = F1 N = 31 Grand mean = -0.432		Deviance: -2 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Nasalisation	Non-nasalised	0.213	26	0.00121
	Nasalised	-0.213	5	
Syllable Type	/ȳCV(C)#/	0.279	14	0.00195
	/CȳC#/	-0.129	6	
	/Cȳ#/	-0.149	11	
Non-significant factor groups were Lexical frequency (p=0.622), and F2 (p=0.656).				

Table 4.21. Female speakers: Results of mixed-effects linear regression for F1 in (ȳN).

The token counts for nasalised and non-nasalised vowels are similar for male and female speakers: both sexes produce less nasalised tokens in sequential nasal units for (ȳN). In spite of this, nasalisation is returned as a significant effect for female, but not for male, speakers. Perhaps the number of nasalised tokens for male speakers (n=3) is not enough to generate a significant effect independently for the F1-nasality correlation.

The regression model for F2 in (ȳN) is presented in Table 4.22 considering male and female speakers' data together. The analysis returned no factor groups as significant: syllable type, lexical frequency, F1, speaker sex, and nasalisation. This

means that the predictive power of each of these fixed effects did not improve on the amount of variation that could be explained by inter-speaker differences and lexical item. Also, nasalisation does not have a significant effect on vowel quality.

Nasal Unit = (ȳN) Dependent variable = F2 N = 61 Grand mean = 0.135	Deviance: -0.015 Degrees of freedom: 10
Non-significant factor groups were Syllable type (p=0.194), Lexical frequency (p=0.224), F1 (p=0.79), Speaker sex (p=0.814), and Nasalisation (p=0.83).	

Table 4.22. All speakers: Results of mixed-effects linear regression for F2 in (ȳN).

Examining variation in the (ēN) sequential nasal unit, the regression model for F1 considering data from both sexes is presented in Table 4.23. Syllable type is the only significant predictor returned: speaker sex, nasalisation, lexical frequency and F2 are all non-significant predictors. Therefore, there is no significant difference in vowel quality (on the basis of F1) between nasalised and non-nasalised tokens of (ēN). For syllable type, medial open stressed syllables favour the highest F1 values, or the lowest vowels, while medial open unstressed syllables favour the lowest F1 values, or the highest vowels. Final closed stressed syllables favour high F1 values while final open stressed syllables favour low F1 values. The magnitude of these correlations is less than for the medial open syllables but overall the correlations are significant at the lower ($p \leq 0.05$) significance level.

Nasal Unit = (ēN) Dependent variable = F1 N = 123 Grand mean = 0.089		Deviance: 88 Degrees of freedom: 11		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/ṽCV(C)#/	0.141	20	0.0193
	/CṽC#/	0.090	45	
	/Cṽ#/	-0.056	33	
	/ṽCV(C)#/ - Unstressed	-0.175	25	
Non-significant factor groups were Speaker sex (p=0.0723), Nasalisation (p=0.575), Lexical frequency (p=0.658), and F2 (p=0.806).				

Table 4.23. All speakers: Results of mixed-effects linear regression for F1 in (ẽN).

The regression analysis for F2 in the (ẽN) nasal unit, presented in Table 4.24, returned no predictors as significant. Nasalisation is also returned as a non-significant predictor of F2 even though we would expect nasopharyngeal coupling to depress F2.

Nasal Unit = (ẽN) Dependent variable = F2 N = 123 Grand mean = 0.54	Deviance: 75 Degrees of freedom: 11
Non-significant factor groups were Syllable type (p=0.139), Nasalisation (p=0.31), Lexical frequency (p=0.621), F1 (p=0.718), and Speaker sex (p=0.818).	

Table 4.24. All speakers: Results of mixed-effects linear regression for F2 in (ẽN).

In Section 4.2.1, varying degrees of overlap were observed for male and female speakers between the high front vowels (ĩN), (ỹN), (ẽN) in sequential nasal units. In order to investigate this further, two regression analyses were undertaken for F1 and F2 respectively which included ‘speaker’ and ‘word’ as random effects and included the nasal unit and speaker sex as fixed effect predictors. These analyses aimed to determine if the identity of the nasal unit could significantly predict F1 and F2 values given the amount of overlap observed in the raw data set. The differential

behaviour of male and female speakers with respect to these distinctions is also examined. Table 4.25 presents the analysis for F1 in which the interaction between speaker sex and nasal unit is returned as a highly significant predictor ($p \leq 0.05$). Both speaker sex and nasal unit are included in the model as main effects but only nasal unit is a significant predictor of F1 values on its own. This result for nasal unit is very highly significant across speakers. Considering the nasal unit main effect, the results show that (ēN) favours significantly higher F1 values than both (ȳN) and (īN), which favour lower F1 values. The magnitude of this distinction is large and vowels in the (ēN) nasal unit are substantially lower overall than vowels in the (ȳN) and (īN) units. This is the expected pattern and confirms that, when male and female speakers are considered together, there is separation between the nasal units on the F1 dimension. The (īN) unit favours lower F1 values than (ȳN). This means that vowels in (īN) are higher overall than vowels in (ȳN) and that the F1 distinction between (ēN) and (īN) is greater than between (ēN) and (ȳN). The interaction terms between speaker sex and nasal unit identity reveal differential patterning for male and female speakers. Male speakers' (ēN) vowels have the highest F1 values overall followed by female speakers' (ȳN) and (īN) vowels. The results show that female speakers' (ȳN) and (īN) vowels are significantly lower in the vowel space than the equivalent vowels for male speakers while at the same time female speakers' (ēN) vowels favour lower F1 values. Therefore, the female speakers' (ēN) vowels are significantly higher than the same vowels for male speakers. The degree of separation between the close vowels and the close-mid vowel is less for female

speakers than for male speakers as they have both lower close vowels and a higher close-mid vowel. This confirms that the increased level of overlap between the high front vowels observed for female speakers in Figure 4.12 when compared with male speakers in Figure 4.8 is significant.

Nasal Unit = (ĩN ãN êN) Dependent variable = F1 N = 236 Grand mean = -0.235		Deviance: 147 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Speaker Sex: Nasal Unit	Male:(êN)	0.096	63	0.00197
	Female:(ãN)	0.072	31	
	Female:(ĩN)	0.024	26	
	Male:(ĩN)	-0.024	26	
	Male:(ãN)	-0.072	30	
	Female:(êN)	-0.096	60	
Nasal Unit	(êN)	0.453	123	[main effect] (3.37e-13)
	(ãN)	-0.160	61	
	(ĩN)	-0.293	52	
Non-significant factor groups were: Speaker sex (p=0.736).				

Table 4.25. All speakers: Results of mixed-effects linear regression for F1 in (iN ỹN ēN).

Table 4.26 presents the regression analysis of F2 in the high front vowels. The speaker sex and nasal unit interaction term is returned as non-significant. The main effect included for nasal unit is very highly significant across speakers. The general pattern observed in the raw data for F2 in the high front vowels is returned by the regression model: (iN) favours higher F2 values across speakers while (ỹN) favours lower F2 values (to a similar extent). The (ēN) vowels occupy an intermediate space on the F2 continuum between these two close vowels. For both

male and female speakers, the separation between the high front nasal units is significantly predicted by nasal unit identity.

Nasal Unit = (iN ĩN ěN) Dependent variable = F2 N = 236 Grand mean = 0.572		Deviance: 135 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Nasal Unit	(iN)	0.540	52	[main effect] (1.16e-12)
	(ěN)	-0.071	123	
	(ĩN)	-0.470	61	
Non-significant factor groups were: Speaker sex (p=0.776) and Speaker sex*Nasal unit (p=0.683).				

Table 4.26. All speakers: Results of mixed-effects linear regression for F2 in (iN ỹN ěN).

The regression model for F1 in the sequential (ãN) nasal unit is provided in Table 4.27 whereby no fixed effects were returned as significant predictors of the variation observed for male and female speakers. The model for F2 in the sequential (ãN) nasal unit is presented in Table 4.28. The analysis returned F1 as the only significant predictor of F2 values for male and female speakers ($p \leq 0.05$). There is a positive correlation between F2 and the value of F1: an increase in F1 entails a fractional increase in F2. Therefore, realisations of the vowel in (ãN) that are lower in the vowel space are also further forward in the vowel space. This effect is just below the level of significance in the F1 model in Table 4.27 ($p=0.0591$). Nasalisation does not affect significantly vowel quality for the (ãN) nasal unit.

Nasal Unit = (ãN) Dependent variable = F1 N = 83 Grand mean = 1.732	Deviance: 77 Degrees of freedom: 11
Non-significant factor groups were F2 (p=0.0591), Lexical frequency (p=0.422), Syllable type (p=0.559), Nasalisation (p=0.721), and Speaker sex (p=0.766).	

Table 4.27. All speakers: Results of mixed-effects linear regression for F1 in (ãN).

Nasal Unit = (ãN) Dependent variable = F2 N = 83 Grand mean = -0.456		Deviance: -37 Degrees of freedom: 11		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.129	83	0.012
Non-significant factor groups were Speaker sex (p=0.104), Syllable type (p=0.554), Nasalisation (p=0.656), and Lexical frequency (p=0.829).				

Table 4.28. All speakers: Results of mixed-effects linear regression for F2 in (ãN).

The regression model for F1 in the final sequential nasal unit, (ũN), is presented in Table 4.29. Two fixed effects are returned by the analysis as significant: F2 ($p \leq 0.01$) and nasalisation ($p \leq 0.05$). F2 exhibits a positive correlation with F1: the magnitude of the correlation is substantial and the relationship is highly significant. This is a similar correlation to that observed for (ãN) above. An increase in F2 entails an increase in F1: this means that centralised realisations of (ũN) are also significantly lowered. The significant effect for nasalisation exhibits the opposite of the expected pattern: nasalised variants favour higher F1 values than non-nasalised vowels. This is at odds with the usual F1-lowering witnessed for nasalised segments. The magnitude of this effect is substantial but the level of significance is low. There is also a reduced token count in the nasalised category which may signal unreliable regression coefficients.

Nasal Unit = (ũN) Dependent variable = F1 N = 74 Grand mean = -0.508		Deviance: 31 Degrees of freedom: 11		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.365	74	0.000325
Nasalisation	Nasalised	0.185	5	0.0401
	Non-nasalised	-0.185	69	
Non-significant factor groups were Speaker sex (p=0.123), Lexical frequency (p=0.43), and Syllable type (p=0.927).				

Table 4.29. All speakers: Results of mixed-effects linear regression for F1 in (ũN).

The regression model for F2 in (ũN) is presented for male and female speakers in Table 4.30. F1 is returned as a significant predictor of F2 which mirrors the pattern observed in Table 4.29 above for the F1 model. The coefficient magnitude of the effect as well as the level of significance are near identical. This confirms the relationship between F1 and F2 for the high back vowel in sequential nasal units: vowel lowering is accompanied by vowel centralisation.

Nasal Unit = (ũN) Dependent variable = F2 N = 74 Grand mean = -1.443		Deviance: 31 Degrees of freedom: 11		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.386	74	0.000354
Non-significant factor groups were Syllable type (p=0.303), Lexical frequency (p=0.53), Speaker sex (p=0.755), and Nasalisation (p=0.867).				

Table 4.30. All speakers: Results of mixed-effects linear regression for F2 in (ũN).

4.2.1.2 MODELLING NON-SEQUENTIAL NASAL UNITS

This section presents the regression analyses for the non-sequential nasal units. For each model presented, the same random and fixed effects, as were included in the sequential models, have been included in the regression analyses (see Table 4.16).

The regression model for F1 in the non-sequential nasal unit (i) is presented in Table 4.31 for male and female speakers. Two fixed effects are returned as significant: lexical frequency ($p \leq 0.01$) and syllable type ($p \leq 0.05$) while three fixed effects are returned as non-significant by the analysis: F2, speaker sex, and nasalisation. Male speakers produce primarily non-nasalised tokens of (i) while female speakers produce near-categorical nasalised vowels. Since both nasalisation and speaker sex are, however, returned as non-significant, it appears that variations in F1 are not correlated to the nasalised versus non-nasalised categories. There is a positive correlation between lexical frequency and the value of F1. The magnitude of this effect is strong and the probability of its occurrence is highly significant. This effect shows that higher frequency lexical items contain tokens of (i) that are concomitantly lower in the vowel space. The significant effect for syllable type reveals that medial open syllables favour high F1 values while final open syllables favour low F1 values with final closed syllables falling roughly in between the two. This means that medial open syllables contain lower realisations of (i) than final open syllables. The probability of this effect is strong and the magnitude of the effect relatively large.

Nasal Unit = (i) Dependent variable = F1 N = 90 Grand mean = -0.578		Deviance: 70 Degrees of freedom: 11		
Factor Group	Factor	Coeff.	N	P-value
Lexical frequency	Continuous (Log-transformed)	0.335	90	0.00158
Syllable type	/ṽCV(C)#/	0.227	11	0.0143
	/CṽC#/	-0.021	26	
	/Cṽ#/	-0.206	53	
Non-significant factor groups were F2 (p=0.123), Speaker sex (p=0.202), and Nasalisation (p=0.22).				

Table 4.31. All speakers: Results of mixed-effects linear regression for F1 in (i).

The regression model for F2 in the (i) nasal unit is presented in Table 4.32 where all fixed effects are returned by the analysis as non-significant predictors of the variation observed. The equivalent model for sequential nasal units also returned no significant predictors for F2 in (iN) (Table 4.18). Thus, the presence of nasalisation does not to significantly depress F2 in they way we might expect. We have seen, however, that for female speakers, only one non-nasalised token of (i) is included in the analysis (because all tokens were coded as nasalised).

Nasal Unit = (i) Dependent variable = F2 N = 90 Grand mean = 1.251	Deviance: 74 Degrees of freedom: 11
Non-significant factor groups were F1 (p=0.0815), Speaker sex (p=0.171), Lexical frequency (p=0.576), Nasalisation (p=0.676), and Syllable type (p=0.748).	

Table 4.32. All speakers: Results of mixed-effects linear regression for F2 in (i).

The regression analysis of F1 in the (ĩ) nasal unit included two significant predictors in the model presented in Table 4.33: nasalisation ($p \leq 0.01$) and speaker

sex ($p \leq 0.01$). For nasalisation, non-nasalised vowels favour relatively higher F1 values while nasalised vowels favour lower overall F1 values. This effect is highly significant and the pattern observed is as expected: nasalised vowels favour lower F1 values or higher vowels due to the effect of nasalisation on the first formant. The effect of speaker sex is also returned as highly significant with female speakers favouring higher F1 values for ($\tilde{y}$) than male speakers. This is the same effect observed for the sequential nasal unit ($\tilde{y}N$) but the magnitude of the effect is larger (see Table 4.19).

Nasal Unit = (ỹ) Dependent variable = F1 N = 70 Grand mean = -0.693		Deviance: 23 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Nasalisation	Non-nasalised	0.129	48	0.00235
	Nasalised	-0.129	22	
Speaker sex	Female	0.142	36	0.00577
	Male	-0.142	34	
Non-significant factor groups were Syllable type (p=0.0724), Lexical frequency (p=0.757), and F2 (p=0.949).				

Table 4.33. All speakers: Results of mixed-effects linear regression for F1 in ($\tilde{y}$).

Given the significant difference between the F1 values of ($\tilde{y}$) for male and female speakers, separate regression models for F1 are provided below. Table 4.34 presents the model for F1 for male speakers where no fixed effects are returned as significant predictors of the variation observed. This mirrors the result for the equivalent test on the sequential nasal unit ($\tilde{y}N$) (Table 4.20). Male speakers do not show the significant effect of nasalisation present in the composite model above (Table 4.33).

Nasal Unit = ($\tilde{y}$) Dependent variable = F1 N = 34 Grand mean = -0.837	Deviance: 12 Degrees of freedom: 9
Non-significant factor groups were Nasalisation (p=0.234), Syllable type (p=0.286), F2 (p=0.424), and Lexical frequency (p=0.87).	

Table 4.34. Male speakers: Results of mixed-effects linear regression for F1 in ($\tilde{y}$).

The model for female speakers is provided in Table 4.35 and nasalisation is returned as a significant predictor of F1, as in the composite model. This significant effect was also present in the female speakers' model for the equivalent sequential nasal unit (Table 4.21). Non-nasalsed vowels favour high F1 values while nasalsed vowels favour low F1 values. The magnitude of this effect is larger than when male and female speakers are considered together but the level of significance is not as strong. The proportions of nasalsed and non-nasalsed tokens are similar for male and female speakers and, as such, cannot explain the non-significant effect returned here for male speakers.

Nasal Unit = ($\tilde{y}$) Dependent variable = F1 N = 36 Grand mean = -0.556		Deviance: 6 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Nasalisation	Non-nasalsed	0.166	25	0.0105
	Nasalsed	-0.166	11	
Non-significant factor groups were Lexical frequency (p=0.57), Syllable type (p=0.0645) and F2 (p=0.76).				

Table 4.35. Female speakers: Results of mixed-effects linear regression for F1 in ($\tilde{y}$).

The regression model for F2 in the non-sequential nasal unit ($\tilde{y}$) is presented in Table 4.36. No fixed effects are returned as significant predictors of the variation observed in F2. The equivalent model for the sequential nasal unit also returned no significant predictors (Table 4.22).

Nasal Unit = (ỹ) Dependent variable = F2 N = 70 Grand mean = 0.163	Deviance: 77 Degrees of freedom: 10
Non-significant factor groups were Nasalisation (p=0.149), Syllable type (p=0.489), F1 (p=0.587), Speaker sex (p=0.653), and Lexical frequency (p=0.687)	

Table 4.36. All speakers: Results of mixed-effects linear regression for F2 in (ỹ).

The results of the regression analysis for F1 in the (ē) nasal unit are provided in Table 4.37. No significant predictors are returned by the analysis. The regression model for F2 in (ē) is presented in Table 4.38. Again, no fixed effects are returned as significant predictors of the variation observed. This indicates that the fixed effects could not explain the variation observed over and above the variation that could be explained by differences between speakers or lexical items. It also indicates that nasalisation does not have a significant effect on vowel quality.

Nasal Unit = (ē) Dependent variable = F1 N = 21 Grand mean = -0.27	Deviance: 11 Degrees of freedom: 9
Non-significant factor groups were F2 (p=0.0538), Lexical frequency (p=0.478), Speaker sex (p=0.505), Nasalisation (p=0.61), and Syllable type (p=0.992).	

Table 4.37. All speakers: Results of mixed-effects linear regression for F1 in (ē).

Nasal Unit = (ē) Dependent variable = F2 N = 21 Grand mean = 0.712	Deviance: 23 Degrees of freedom: 9
Non-significant factor groups were F1 (p=0.0554), Speaker sex (p=0.0961), Syllable type (p=0.248), Lexical frequency (p=0.343), Nasalisation (p=0.374).	

Table 4.38. All speakers: Results of mixed-effects linear regression for F2 in (ē).

As with the sequential nasal units, it is necessary to examine the extent to which the three high front vowels (ī ỹ ē) are separate on the F1 and F2 dimensions in non-sequential nasal units. The model for F1 including male and female speakers, with ‘speaker’ and ‘word’ as random effects and ‘nasal unit’ and ‘speaker sex’ as

fixed effects, is presented in Table 4.39. The speaker sex and nasal unit interaction term is found to be significant ($p=0.012$) and both main effects are returned as significant in a simple mixed-effects model: speaker sex ($p\leq 0.05$) and nasal unit identity ($p\leq 0.01$). The highly significant result for nasal unit shows that (ẽ) favours relatively high F1 values while (ỹ) favours the lowest F1 values. The (ĩ) nasal unit favours intermediate F1 values. This demonstrates that, while (ẽ) vowels are significantly lower than (ĩ) and (ỹ), (ĩ) vowels are also significantly lower than (ỹ) vowels. This is a different pattern than the one observed for the equivalent sequential nasal units (Table 4.25) in which (ẽN) vowels were significantly lower than (ĩN) and (ỹN) but, on the other hand, (ĩN) vowels were significantly higher than (ỹN) vowels, which is not the case for non-sequential units. The probability of the interaction effect is just below the threshold for high statistical significance and the pattern of regression coefficients mirrors the pattern observed in Table 4.25 for the equivalent sequential nasal units. The magnitude in the non-sequential environment is, however, larger than in the sequential environment. Female speakers again exhibit lowering of the close vowels and raising of the close-mid vowel, a pattern which has lead to increased levels of overlap between the three vowels for female speakers when compared with male speakers.

Nasal Unit = (ĩ ÿ ě)		Deviance: 142 Degrees of freedom: 9		
Dependent variable = F1				
N = 181				
Grand mean = -0.587				
Factor Group	Factor	Coeff.	N	P-value
Speaker Sex: Nasal Unit	Male:(ě)	0.145	9	0.012
	Female:(ÿ)	0.119	36	
	Female:(ĩ)	0.026	46	
	Male:(ĩ)	-0.026	44	
	Male:(ÿ)	-0.119	34	
	Female:(ě)	-0.145	12	
Speaker sex	Female	0.022	94	[main effect] (0.0192)
	Male	-0.022	87	
Nasal Unit	(ě)	0.257	21	[main effect] (0.000707)
	(ĩ)	-0.069	90	
	(ÿ)	-0.187	70	

Table 4.39. All speakers: Results of mixed-effects linear regression for F1 in (ĩ ÿ ě).

The significant result for speaker sex may be investigated further by considering the sexes separately. The model in Table 4.40 examines the probability of nasal unit identity predicting the F1 values observed for male speakers. The expected pattern of regression coefficients is evident and the significance of this effect is very highly significant: (ě) favours lower vowels than (ĩ) and (ÿ) which favour lower F1 values.

Nasal Unit = (ĩ ÿ ě)		Deviance: 75 Degrees of freedom: 6		
Dependent variable = F1				
N = 87				
Grand mean = -0.657				
Factor Group	Factor	Coeff.	N	P-value
Nasal Units	(ě)	0.405	9	0.000863
	(ĩ)	-0.101	44	
	(ÿ)	-0.304	34	

Table 4.40. Male speakers: Results of mixed-effects linear regression for F1 in (ĩ ÿ ě).

The model presented in Table 4.41 shows the probability of nasal unit identity predicting the F1 values of (ĩ ÿ ě) for female speakers. This single factor group fails to reach the level of statistical significance. This means that the different nasal units cannot predict F1 values reliably for female speakers and that they do not distinguish significantly between these vowels in terms of height for the non-sequential nasal units.

Nasal Unit = (ĩ ÿ ě) Dependent variable = F1 N = 94 Grand mean = -0.521	Deviance: 66 Degrees of freedom: 6
Non-significant factor groups were Nasal unit (p=0.289).	

Table 4.41. Female speakers: Results of mixed-effects linear regression for F1 in (ĩ ÿ ě).

Table 4.42 presents the model for F2 in the high front vowels and again aims to examine the predictive potential of the appropriate nasal unit identity for the F2 values observed. The interaction between nasal unit identity and speaker sex is not returned as significant by the model but a simple mixed-effects model returns both speaker sex and nasal unit identity as significant predictors of F2. Beginning with the nasal unit factor group, the result is very highly significant and the range of the regression coefficients is large. The expected arrangement of the vowels along the F2 continuum is returned as significant by the regression analysis: (ĩ) favours high F2 values while (ÿ) favours the lowest F2 values of the three vowels. (ě) is located between these two extremes with relatively neutral F2 values. This shows that when all speakers are considered together, these vowels are distinguished by variations in frontness/backness. This effect is the same as that observed for the equivalent sequential nasal units (Table 4.26). The effect for speaker sex is significant at the lower significance level ($p \leq 0.05$).

Nasal Unit = (ĩ ÿ ě) Dependent variable = F2 N = 181 Grand mean = 0.768		Deviance: 199 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Speaker sex	Male	0.11	87	[main effect] (0.0183)
	Female	-0.11	94	
Nasal Unit	(ĩ)	0.532	90	[main effect] (4.63e-14)
	(ě)	-0.024	21	
	(ỹ)	-0.556	70	
Non-significant factor groups were: Speaker sex*Nasal unit (p=0.215).				

Table 4.42. All speakers: Results of mixed-effects linear regression for F2 in (ĩ ÿ ě).

The model for male speakers is presented in Table 4.43 including nasal unit identity as the only fixed effect. This is returned as a highly significant predictor of F2 ($p \leq 0.01$). The coefficient magnitudes are comparable to those included in the composite model for male and female speakers (Table 4.42). While (ĩ) and (ÿ) are predictors of the extreme F2 values in the high front area of the vowel space, the coefficient pertaining to (ě) is markedly positive in comparison with its equivalent coefficient in Table 4.42. This shows that (ě) is more positively correlated to F2 for male speakers or that it favours F2 values that are fronter and closer to (ĩ) than to (ÿ).

Nasal Unit = (i ỹ ě)		Deviance: 12 Degrees of freedom: 6		
Dependent variable = F2				
N = 87				
Grand mean = 0.848				
Factor Group	Factor	Coeff.	N	P-value
Nasal Units	(i)	0.489	44	2.75e-15
	(ě)	0.137	9	
	(ỹ)	-0.625	34	

Table 4.43. Male speakers: Results of mixed-effects linear regression for F2 in (i ỹ ě).

The model for female speakers is presented in Table 4.44. Again, the effect of nasal unit identity is returned as highly significant ($p \leq 0.01$) and the magnitude of the regression coefficients is comparable to the composite model and to the male speakers in Table 4.43 above. The regression coefficient for (ě) for female speakers shows the nasal unit favours relatively low F2 values though the magnitude of this effect is small. This shows that while there was a tendency for (ě) to be nearer to (i) for male speakers, the opposite is true of female speakers where (ě) predicts F2 values that are closer to those of (ỹ) than to those of (i). Note that the nasal unit identity of the three high front vowels can predict F2 values for both male and female speakers. This was not true for F1 where female speakers did not make a significant vowel height distinction between the vowels. Therefore, for non-sequential units, male speakers distinguish between (i ỹ ě) on both the F1 and F2 dimensions while female speakers make the distinction between the high front vowels primarily in terms of F2.

Nasal Unit = (ĩ ÿ ě) Dependent variable = F2 N = 94 Grand mean = 0.694		Deviance: 145 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Nasal Unit	(ĩ)	0.577	46	1.26e-08
	(ě)	-0.090	12	
	(ÿ)	-0.487	36	

Table 4.44. Female speakers: Results of mixed-effects linear regression for F2 in (ĩ ÿ ě).

Returning to individual nasal units, the regression model for F1 in the non-sequential unit (ã) is presented in Table 4.45. Three significant predictors of F1 are returned by the analysis as significant: F2 ($p \leq 0.01$), nasalisation ($p \leq 0.01$), and speaker sex ($p \leq 0.05$). There is a positive correlation between F2 and the values of F1. This means that when the vowel in (ã) is fronter, there is a high probability that it is also substantially lower. The magnitude of this effect is very large and the effect is very highly statistically significant. The significant result for nasalisation exhibits the expected pattern for F1: nasalised tokens favour low F1 values while non-nasalised vowels favour high F1 values. The nasalised vowels are therefore higher in the vowel space than the non-nasalised vowels. The magnitude of this effect is substantial and the effect is very highly significant. The significant effect for speaker sex is just below the ‘highly significant’ level. The regression coefficients suggest that male speakers produce more open vowels (higher F1 values) than female speakers. To examine the differences between F1 values for male and female speakers, it is necessary to look at regression models that have been separated by sex.

Nasal Unit = (ã) Dependent variable = F1 N = 56 Grand mean = 1.791		Deviance: 70 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	1.118	56	1.72e-05
Nasalisation	Non-nasalised	0.251	23	0.000165
	Nasalised	-0.251	33	
Speaker sex	Male	0.179	30	0.0124
	Female	-0.179	26	
Non-significant factor groups were Syllable type (p=0.125), and Lexical frequency (p=0.849).				

Table 4.45. All speakers: Results of mixed-effects linear regression for F1 in (ã).

The model for F1 for male speakers is provided in Table 4.46. Only F2 is returned by the analysis as a significant predictor ($p \leq 0.05$) of F1 for (ã). As above, F2 is positively correlated to F1: front vowels have a high probability of being lower in the vowel space. The magnitude of the effect is smaller than when all speakers are considered together and the level of significance returned is reduced to the lower level for statistical significance ($p \leq 0.05$).

Nasal Unit = (ã) Dependent variable = F1 N = 30 Grand mean = 1.811		Deviance: 28 Degrees of freedom: 8		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.824	30	0.0192
Non-significant factor groups were Nasalisation (p=0.0565), Syllable type (p=0.113), and Lexical frequency (p=0.423).				

Table 4.46. Male speakers: Results of mixed-effects linear regression for F1 in (ã).

The regression model for F1 is presented for female speakers in Table 4.47. There is a strong positive correlation between F2 and the F1 values. The magnitude of the regression coefficient is very large and the significance of the effect is very high

($p \leq 0.01$). Nasalisation was a significant predictor in the composite model but not when male speakers were considered separately. Nasalisation is a highly significant predictor of F1 for female speakers ($p \leq 0.01$). The expected pattern emerges once more from the analysis of female speakers: nasalised tokens favour lower F1 values or higher vowels than non-nasalised tokens. The magnitude of this effect is larger than when all speakers were considered together.

Nasal Unit = (ã) Dependent variable = F1 N = 26 Grand mean = 1.769		Deviance: 35 Degrees of freedom: 8		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	1.758	26	0.000408
Nasalisation	Non-nasalised	0.226	13	0.0085
	Nasalised	-0.226	13	
Non-significant factor groups were Lexical frequency (p=0.463), and Syllable type (p=0.873).				

Table 4.47. Female speakers: Results of mixed-effects linear regression for F1 in (ã).

The regression model for F2 in (ã) is presented in Table 4.48 where four fixed effects are returned as significant predictors: F1 ($p \leq 0.01$), nasalisation ($p \leq 0.05$), speaker sex ($p \leq 0.05$), and syllable type ($p \leq 0.05$). Beginning with the strongest predictor, there is a positive correlation between F1 and the value of F2. This highly significant effect mirrors the finding for F1 above: increases in F1 predict increases in F2. This means that lower vowels have a high probability of being fronter. The magnitude for the regression coefficient is substantially less than for the correlation between F1 and F2 in Table 4.45 above. Nasalisation is a significant predictor of F2 at the lower significance level ($p \leq 0.05$): nasalised variants favour higher F2 values while non-nasalised variants favour lower F2 values. This is at odds with the tendency for nasal coupling to lower the value of F2. Nasalised

variants of (ã) are significantly fronter than non-nasalised variants. The effect of syllable type is also significant at the lower significance level: final closed syllables favour higher F2 values while final open syllables favour low F2 values. This means that (ã) vowels in closed syllables are significantly fronted relative to (ã) vowels in open syllables. The statistical analysis revealed, however, that there was no significant interaction between nasalisation and syllable type for (ã). There is also a significant effect for speaker sex: the regression coefficients suggest that female speakers favour higher F2 values than male speakers.

Nasal Unit = (ã) Dependent variable = F2 N = 56 Grand mean = -0.511		Deviance: -22 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.239	56	2.83e-06
Nasalisation	Nasalised	0.073	33	0.0145
	Non-nasalised	-0.073	23	
Speaker sex	Female	0.115	26	0.0285
	Male	-0.115	30	
Syllable type	/C $\tilde{v}$ C#/	0.096	16	0.038
	/C $\tilde{v}$ #/	-0.096	40	
Non-significant factor groups were Lexical frequency (p=0.949).				

Table 4.48. All speakers: Results of mixed-effects linear regression for F2 in (ã).

The regression model for F2 considering only male speakers is presented in Table 4.49. The same three fixed effects were returned as significant predictors of F2: syllable type ($p \leq 0.01$), F1 ($p \leq 0.05$), and nasalisation ($p \leq 0.05$). The highly significant effect for syllable type shows the same pattern for male speakers: final closed syllables favour higher F2 values than final open syllables. The magnitude of the

regression coefficients is larger than when all speakers are considered together. There is also a significant positive correlation between F1 and F2 which shows a similar magnitude effect to the composite model in Table 4.48. The effect of nasalisation on F2 is significant for male speakers who exhibit a near identical pattern to the composite model: nasalised vowels are significantly fronted relative to non-nasalised vowels. Again, this finding is contrary to previous findings showing F2 to be depressed by nasalisation.

Nasal Unit = (ã) Dependent variable = F2 N = 30 Grand mean = -0.606		Deviance: -13 Degrees of freedom: 8		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C $\tilde{v}$ C#/	0.145	9	0.00266
	/C $\tilde{v}$ #/	-0.145	21	
F1	Continuous variable	0.216	30	0.0123
Nasalisation	Nasalised	0.097	20	0.0304
	Non-nasalised	-0.097	10	
Non-significant factor groups were Lexical frequency (p=0.147).				

Table 4.49. Male speakers: Results of mixed-effects linear regression for F2 in (ã).

The regression model for female speakers is presented in Table 4.50. Only one fixed effect is returned by the analysis as a significant predictor of F2: F1 ($p \leq 0.01$). This highly significant effect shows a positive correlation between F1 and F2. The magnitude of the effect is comparable to the effects returned for male speakers (Table 4.49) or for all speakers together (Table 4.48).

Nasal Unit = (ã) Dependent variable = F2 N = 26 Grand mean = -0.401		Deviance: -16 Degrees of freedom: 8		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.241	26	4.33e-05
Non-significant factor groups were Nasalisation (p=0.223), Lexical frequency (p=0.588), and Syllable type (p=0.73).				

Table 4.50. Female speakers: Results of mixed-effects linear regression for F2 in (ã).

The regression models for F1 and F2 in the final non-sequential nasal unit (ũ) are presented in Tables 4.51 and 4.52 respectively. There are no significant predictors included in the F1 model. The model for F2 returns one significant predictor: nasalisation ($p \leq 0.05$). This effect is significant at the lower significance level. The pattern revealed by the regression coefficients is the opposite of that observed for F2 in (ã) vowels above. For (ũ), nasalised variants favour lower F2 values than non-nasalised variants meaning that nasalised vowels are significantly more back than non-nasalised vowels. This finding conforms to the expected correlation of nasalisation for the second formant frequency. The sequential model for F2 returned only F1 as a significant predictor.

Nasal Unit = (ũ) Dependent variable = F1 N = 65 Grand mean = -0.69	Deviance: 6 Degrees of freedom: 10
Non-significant factor groups were Syllable type (p=0.165), F2 (p=0.2), Lexical frequency (p=0.47), Speaker sex (p=0.781), and Nasalisation (p=0.982).	

Table 4.51. All speakers: Results of mixed-effects linear regression for F1 in (ũ).

Nasal Unit = (ũ) Dependent variable = F2 N = 65 Grand mean = -1.548		Deviance: 21 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Nasalisation	Non-nasalsed	0.113	53	0.0272
	Nasalsed	-0.113	12	
Non-significant factor groups were F1 (p=0.199), Syllable (p=0.363), Speaker sex (p=0.603), and Lexical frequency (p=0.794).				

Table 4.52. All speakers: Results of mixed-effects linear regression for F2 in (ũ).

Table 4.53 summarises the differences between the regression models for the two lexical sets. For /iN/, there are no significant predictors of F2 in both sequential and non-sequential lexical sets. There is, however, a difference between the predictors returned for F1 in sequential (iN) (no significant predictors) and non-sequential (i) (lexical frequency; syllable type). The predictors of F1 returned by the sequential and non-sequential models for /ỹN/ are the same (speaker sex; nasalisation) as are the predictors of F2 (no significant predictors). For /ẽN/, the F2 models return no significant predictors for both lexical sets but the results for F1 are different: syllable type is a significant predictor of F1 in the sequential model; no fixed effects are returned as significant for the non-sequential model. In the sequential environment, only F1 is returned as a significant predictor of F2 for (ãN) while no fixed effects were returned as significant for F1. For the non-sequential models of F1 and F2 for (ã), on the other hand, F1/F2 correlation, nasalisation and speaker sex are all returned as significant predictors. Additionally, syllable type is a significant predictor of F2 for (ã). Finally, comparing the F1 models for (ũN) and (ũ), F2 and nasalisation are significant predictors in the sequential environment but

no significant effects are returned by the non-sequential model. For F2, F1 is a significant predictor in the sequential environment but this is not the case for the non-sequential model where only nasalisation is returned as a significant predictor of F2 values. Overall, the vowels in nasal units can be seen to exhibit different distributions in different phonetic environments (sequential versus non-sequential) and in the factors that successfully predict the variation observed in these distributions across speakers.

Formant	Sequential Nasal Units			Non-sequential Nasal Units		
	Vowel	Predictor	p-value	Vowel	Predictor	p-value
F1	(iN)	No predictors	-	(i)	Lexical frequency	0.00158
					Syllable type	0.0143
	(ỹN)	Speaker sex	0.00488	(ỹ)	Speaker sex	0.00577
		Nasalisation	0.0399		Nasalisation	0.00235
	(ẽN)	Syllable type	0.0193	(ẽ)	No predictors	-
	(ãN)	No predictors	-	(ã)	F2	1.72e-05
					Nasalisation	0.000165
					Speaker sex	0.0124
	(ũN)	F2	0.000325	(ũ)	No predictors	-
		Nasalisation	0.0401			
F2	(iN)	No predictors	-	(i)	No predictors	-
	(ỹN)	No predictors	-	(ỹ)	No predictors	-
	(ẽN)	No predictors	-	(ẽ)	No predictors	-
	(ãN)	F1	0.012	(ã)	F1	2.83e-06
					Nasalisation	0.0145
					Speaker sex	0.0285
					Syllable type	0.038
	(ũN)	F1	0.000354	(ũ)	Nasalisation	0.0272

Table 4.53. Summary of regression models for F1 and F2 in sequential and non-sequential lexical sets.

4.2.2 LIP-ROUNDING AND F3

This section examines the correlation between lip-rounding and F3 as well as the use of this correlation in distinguishing between the vocalic elements of the /iN/ and /ỹN/ nasal units whereby the feature [+round] distinguishes the latter from the former. The discussion presented here includes data for F3 in the high back rounded vowels of the /ũN/ nasal unit for comparison. The data are separated by lexical set (sequential or non-sequential), as above. Male and female speakers are examined separately and individual speaker means form the basis for the discussion of F3.

Figure 4.15 presents the F3 speaker means and standard deviations in sequential units for individual male speakers. All male speakers, with the exception of Speaker H, separate the vowel in [iN] from [ỹN] and [ũN] on the basis of F3. These speakers also exhibit varying overlap between the F3 distributions of [ỹN] and [ũN] for which some speakers (I and J) have very similar mean values and very little variability around the means while other speakers (F and G) exhibit mean separation and larger amounts of variability. This suggests that [iN] and [ỹN] are distinguished by lip-rounding of the latter and that the rounded vowels, [ỹN] and [ũN], have similar F3 values. In all cases, except for Speaker I, the mean value for [ỹN] is higher than that of [ũN] but the standard deviations around the means for Speakers I and J suggest that this distinction is not realised consistently. Speaker H is anomalous in that the distributions of [ỹN] and [ũN] are separate while the F3 values of [iN] and [ỹN] overlap. Speaker H makes no apparent distinction between [iN] and

[ỹN] on the basis of lip-rounding. He does, however, have separate means and non-overlapping distributions for the high front vowels on the basis of F2 in sequential (Figure 4.8) and non-sequential (Figure 4.10) nasal units. We may also note that Speaker I's low F3 value for [iN] is anomalous with respect to most other speakers.

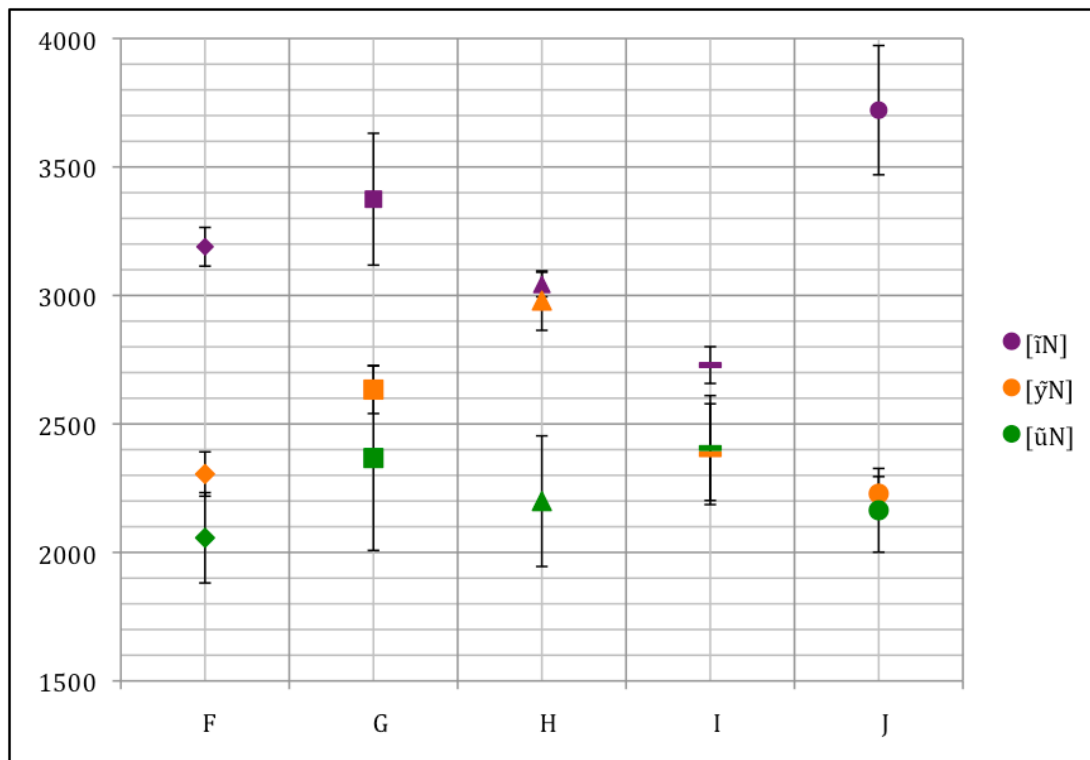


Figure 4.15. Male speakers: Mean F3 values and standard deviations for sequential nasal units.

For non-sequential units, Figure 4.16 provides F3 speaker means and standard deviations for male speakers. The patterns observed for F3 in sequential nasal units are largely the same across male speakers in the non-sequential units. All speakers, except for Speaker H, make a distinction between unrounded [i] and rounded [ỹ]/[ũ] and have overlapping F3 distributions for the rounded vowels. The magnitude of the separation between the unrounded vowel and the rounded vowels varies across speakers in both sequential and non sequential units: Speaker I makes the smallest distinction while Speaker J makes the largest.

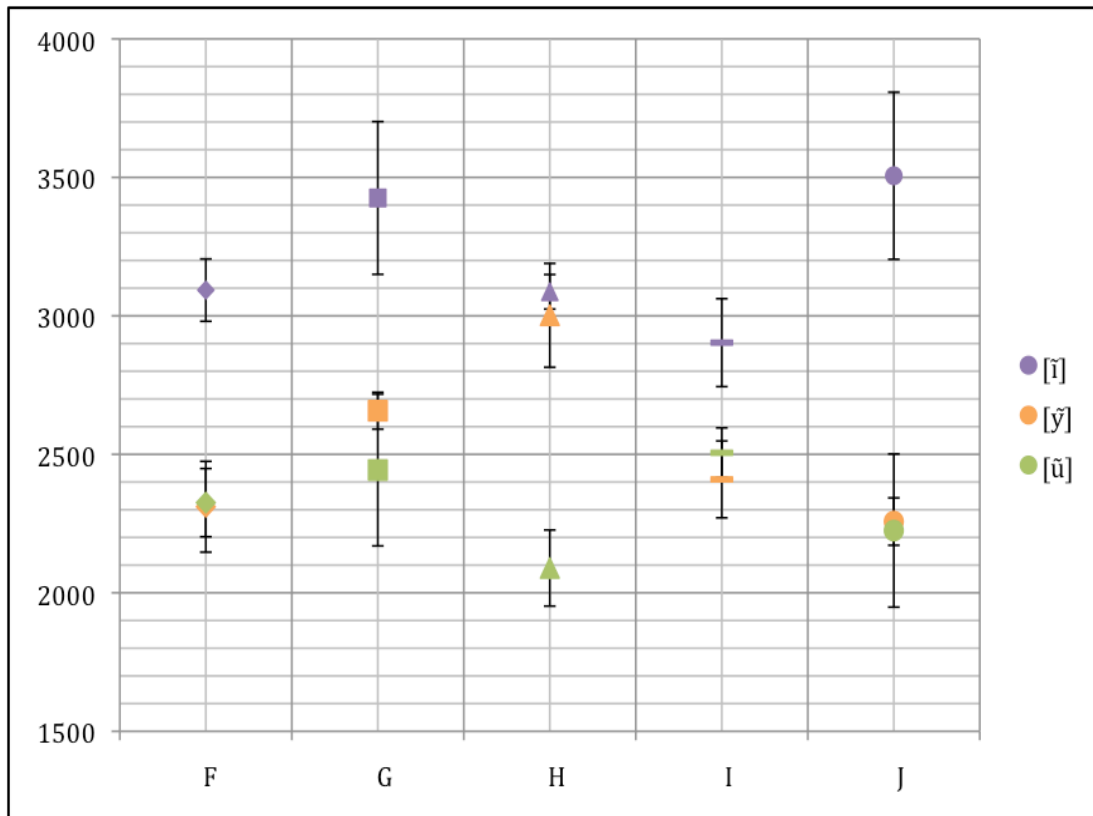


Figure 4.16. Male speakers: Mean F3 values and standard deviations by speakers for non-sequential nasal units.

Speaker means and standard deviations for F3 in the high vowels in sequential nasal units are presented in Figure 4.17 for female speakers. All speakers have separate distributions for F3 between the unrounded and rounded vowels in [ĩN] and [ỹN]. Where F3 was generally very close for most male speakers' [ỹN] and [ũN], the situation for female speakers is somewhat different. Speakers A and C show the expected overlapping distribution between the two rounded vowels but Speakers B, D and E appear to make a phonetic distinction between vowels in [ỹN] and [ũN]: F3 is higher for the front rounded vowel. Speaker C has an F3 pattern that differs from all (male and female) Béarnais speakers for the high vowels: the mean F3 value for [ũN] is greater than that of [ỹN] and the standard deviation of [ũN] overlaps marginally with [ĩN].

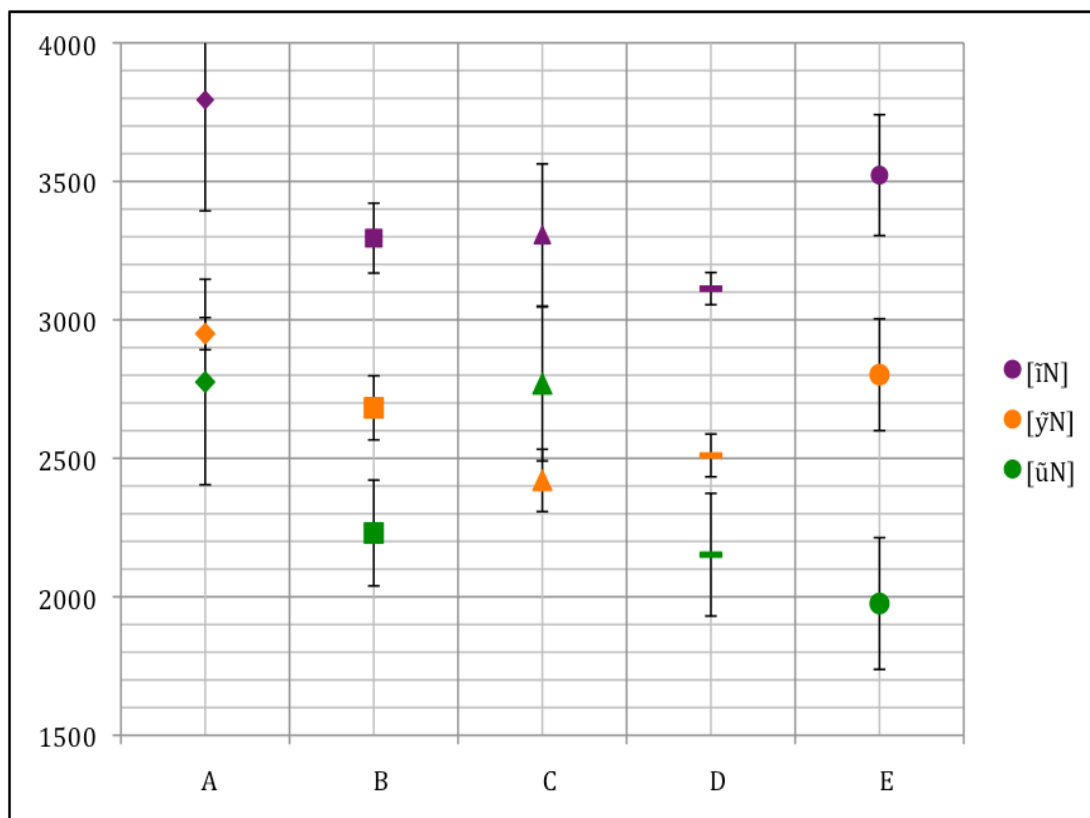


Figure 4.17. Female speakers: Mean F3 values and standard deviations for sequential nasal units.

The data for non-sequential units is presented in Figure 4.18. As for sequential units, female speakers make an F3 distinction between unrounded [ĩ] and the rounded vowels. There is more overlap evident between the rounded vowels [ỹ] and [ũ] in non-sequential nasal units than in sequential nasal units. Speakers A and C show the same overlapping distribution but Speaker B also shows overlap for [ỹ] and [ũ] and Speaker D exhibits only marginal separation between the vowels on the basis of F3. Speaker E maintains separation between the three vowels, as was the case for the sequential units. Speakers B and C exhibit the anomalous pattern with overlapping distributions for the rounded vowels but a higher mean F3 value for [ũ] than for [ỹ]. This was also true of Speaker C, but not of Speaker B, in sequential units.

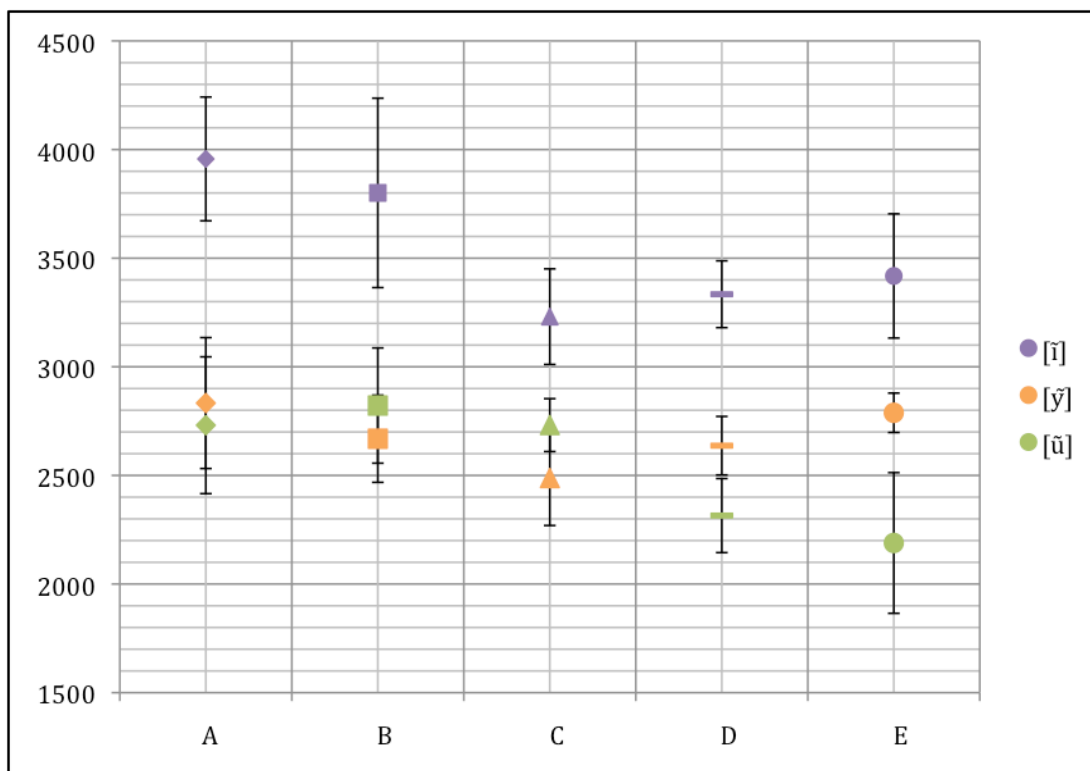


Figure 4.18. Female speakers: Mean F3 values and standard deviations for non-sequential nasal units.

Overall, the distinction between high rounded and unrounded vowels correlates to higher F3 values for unrounded vowels for both male and female speakers (with the exception of Speaker H for both lexical sets and, to a lesser extent, Speaker C in sequential units).

4.2.2.1 MODELLING LIP-ROUNDING AND F3

This final section presents two statistical analyses which model the correlation between the labial feature [+round] and its widely attested acoustic correlate, F3.

The analyses focus on the close nasal units /iN ʏN ũN/ in both sequential and non-sequential nasal units as presented in Section 4.2.2.

The regression model for F3 in sequential units, including ‘speaker’ and ‘word’ (random effects) and ‘speaker sex’ and ‘nasal unit’ (fixed effects), is presented in Table 4.54. A speaker sex and nasal unit identity interaction term was

also included in the complex regression model. This interaction term is returned by the regression analysis as non-significant ($p=0.984$). In a simple regression model (without an interaction term), speaker sex is returned as non-significant ($p=0.108$). Therefore, male and female speakers do not exhibit significantly different distributions for F3 in the vowels of the close nasal units. Nasal unit identity, however, is returned as a very highly significant predictor of F3. This result shows that the feature [+round] significantly predicts the value of F3 across speakers. The (iN) unit favours high F3 values while both (yN) and (uN) favour low F3 values. Rounded segments thus have substantially lower F3 values than the unrounded segments, the expected acoustic correlate of lip-rounding. For (uN), however, F3 values are significantly lower than those of (yN).

Nasal Unit = (ĩN ãN üN) Dependent variable = F3 N = 187 Grand mean = -0.206		Deviance: 360 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Nasal Unit	(ĩN)	1.293	52	[main effect] (2.57e-17)
	(ãN)	-0.374	61	
	(üN)	-0.920	74	
Non-significant effects were: Speaker sex*Nasal unit (p=0.984) and Speaker sex (p=0.108).				

Table 4.54. All speakers: Results of mixed-effects linear regression for F3 in (iN yN uN).

The same regression model for F3 in non-sequential nasal units is presented in Table 4.55. As for the sequential model, the speaker sex and nasal unit interaction term and speaker sex are returned by the analysis as non-significant predictors. The nasal unit factor group is a highly significant predictor of F3 ($p \leq 0.01$). The same pattern emerges for the regression coefficients: rounded vowels (y) and (u) favour

lower F3 values while the unrounded vowel (i) favours high F3 values. The magnitude of the difference in coefficient values for (ỹ) and (ũ) show that the F3 separation between these vowels is somewhat less than for the equivalent vowels in sequential nasal units.

Nasal Unit = (ĩ ã ü)		Deviance: 428		
Dependent variable = F3		Degrees of freedom: 9		
N = 225				
Grand mean = 0.193				
Factor Group	Factor	Coeff.	N	P-value
Nasal Unit	(ĩ)	1.335	90	[main effect] (1.07e-21)
	(ã)	-0.460	70	
	(ü)	-0.875	65	
Non-significant effects were: Speaker sex*Nasal unit (p=0.306) and Speaker sex (p=0.396).				

Table 4.55. All speakers: Results of mixed-effects linear regression for F3 in (i ỹ ũ).

Overall, in both sequential and non-sequential nasal units, speakers distinguish between the vowels in Béarnais /iN/, /ỹN/, and /ũN/ on the basis of F3. The magnitude of the regressions coefficients in each case show that the front unrounded vowel is significantly separated from both of the rounded vowels and that less of a distinction is made between /ỹN/ and /ũN/ which both favour low F3 values.

4.2.3 NASAL CONSONANT CODAS

The final part of this section on the Béarnais nasal units examines the relationship between consonant place of articulation in sequential nasal units and the following phonemic environment. Table 4.56 presents a selection of data from the Béarnais sequential nasal unit data set, where a nasal consonant coda is lexically specified. All speakers have been included and data from all five nasal units has been pooled.

Following Phoneme	Consonant Quality		
	[n]	[m]	[ŋ]
# (pause)	50	18	1
/p/	0	25	0
/b/	0	14	0
/t/	61	0	0
/d/	6	0	0
/k/	6	0	71
/g/	1	0	14
/s/	45	17	0
/ʃ/	10	0	0

Table 4.56. All speakers: The relationship between nasal consonant coda place of articulation and following phoneme.

Pre-pausally, lexically specified /n/ and /m/ surface as [n] and [m] respectively,

for example, *bén* [bɛ̃n] ('vent'), *poun* [pũn] ('pont'), *toustém* [tus'tɛ̃m] ('toujours').

The one exception is an [ŋ], which is a realisation of /n/ in the word *an* /ã̃n/ ('an').

Before stops there is a phonologised pattern of place assimilation: [m] occurs before all labial consonants, [n] occurs before all dentals, and [ŋ] occurs before velars.

However, six nasals before /k/ and one token before /g/ are realised as [n]. The

lexical items involved were: *cinc* /sĩŋk/ ('cinq'), *dinque* /'dĩŋkə/ (jusque), *mançà*

/mãŋ'ka/ ('manquer'), *banque* /'bãŋkɔ/ ('banque'), and *dounc* /dũŋk/ ('donc') for /k/; *doungues* /'dũŋgɔs/ ('donc') for /g/. Other tokens of these words contained a homorganic consonant. It is possible that these realisations of /ŋ/ as [n] are a consequence of the methodology used: words were produced in isolation and speech was normally very careful. The pattern of place assimilation applies equally to the alveolar and postalveolar fricatives /s/ and /ʃ/: the majority pattern is alveolar [n]. However, there are also lexically specified exceptions to this pattern (for example, *téms* /tẽms/ ('temps') and *héms* /hẽms/ ('foin')), hence the 17 tokens of [m] preceding /s/.

4.3 FRENCH MID-VOWELS

This section presents the French vowel space for the ten bilingual speakers focusing on the mid-vowels. As for Béarnais, a general overview of the position of the vowels within the oral vowel space will first be presented followed by an in-depth examination of the front mid-vowels, /e/ and /ɛ/ (Section 4.3.1), and the back mid-vowel(s), /o/ and /ɔ/ (Section 4.3.2).

The French mid-vowels and reference vowels are summarised schematically in Figure 4.19. Note that the front rounded vowels /y/, /œ/, and /ø/ have been excluded due to the difficulty involved in distinguishing them from the front unrounded vowels, /i/, /e/ and /ɛ/, on the basis of F1 and F2 alone.

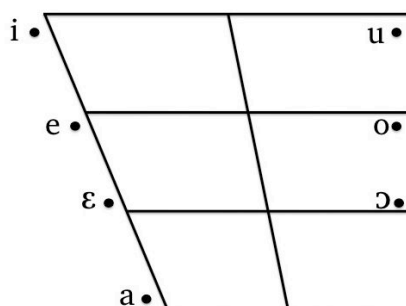


Figure 4.19. French oral vowels (without /y ø œ/)

Token counts for the mid-vowels are presented in Table 4.57 for male (F-J) and female (A-E) speakers for each of the four vowels under investigation. Token counts are comparable across speakers but there are more tokens for /ε/ and /o/ than for /e/ and /ɔ/. The reference vowels (/i/ /u/ /a/) are plotted using F1 and F2 values from approximately 15 tokens per speaker.

Sex	Speaker	/e/	/ε/	/o/	/ɔ/
F	A	19	23	28	18
	B	17	27	33	12
	C	15	29	27	18
	D	20	28	38	6
	E	14	25	25	13
M	F	22	22	28	14
	G	22	23	31	15
	H	25	21	20	23
	I	19	24	20	23
	J	23	24	20	20
Total		196	246	277	155

Table 4.57. Token counts for French mid-vowels by speaker (F = female; M = male).

F1 and F2 values (non-normalised data) for tokens of the mid- and reference vowels produced by male speakers are presented in Figure 4.20. There is overlap between the mid-vowels and the reference vowels when all speakers are considered

together. There is also some overlap in the centre of the vowel space between the front and back vowels. The general position of the vowels conforms to the schematised vowel space in Figure 4.19: two front mid-vowels, /e/ and /ɛ/, between /i/ and /a/; two back mid-vowels, /o/ and /ɔ/, between /u/ and /a/. We may note that the distributions of the back mid-vowels, /o/ and /ɔ/, exhibit substantially more overlap than the front mid-vowels, /e/ and /ɛ/. Figure 4.21 presents the non-normalised mean F1 and F2 values and standard deviations for the mid- and reference vowels of individual male speakers. This plot shows that, for all speakers, there is no overlap in the front of the vowel space between the mid-vowels, /e/ and /ɛ/, and the reference vowels, /i/ and /a/. The situation in the back of the vowel space is somewhat different. All speakers maintain separation between the low reference vowel /a/ and the back mid-vowels, /o/ and /ɔ/, but only Speaker F shows full separation between the back mid-vowels and the high back reference vowel /u/. For the other speakers, there are varying degrees of overlap present between /u/ and the back mid-vowels (primarily /o/), though in most cases the overlap is minimal.

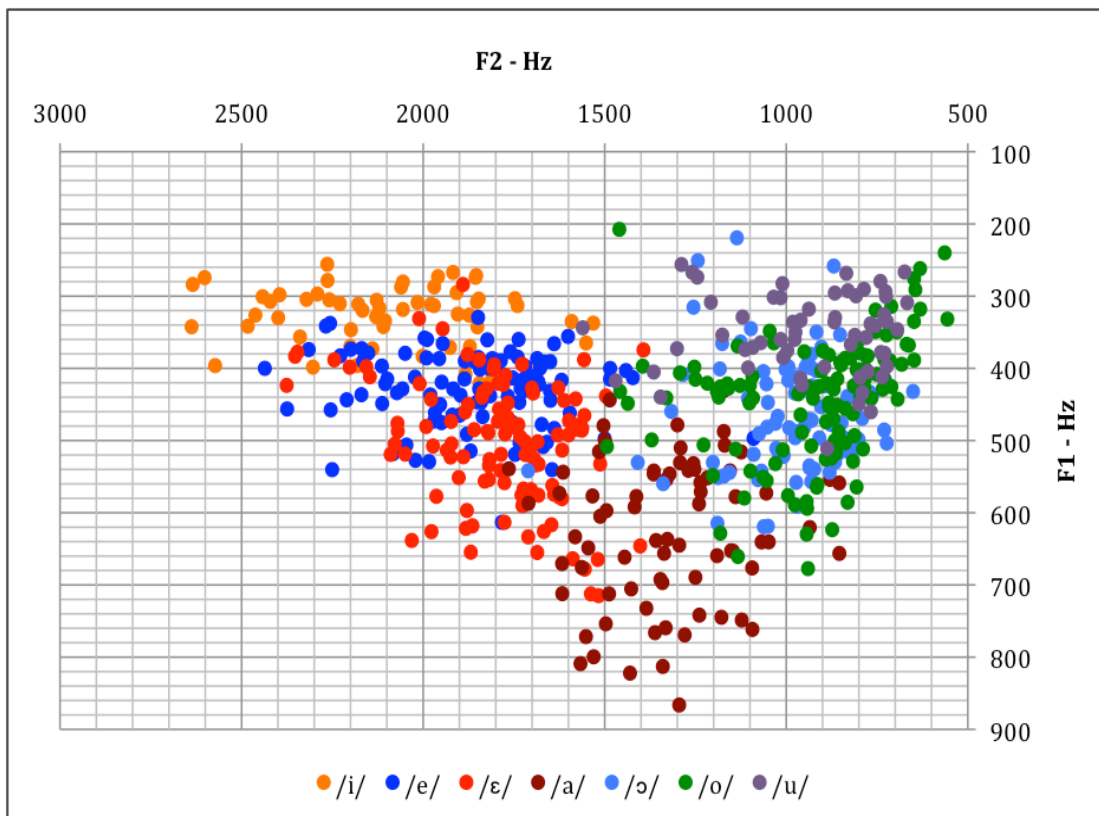


Figure 4.20. Male speakers: F1 and F2 values for French mid-vowels with reference vowels.

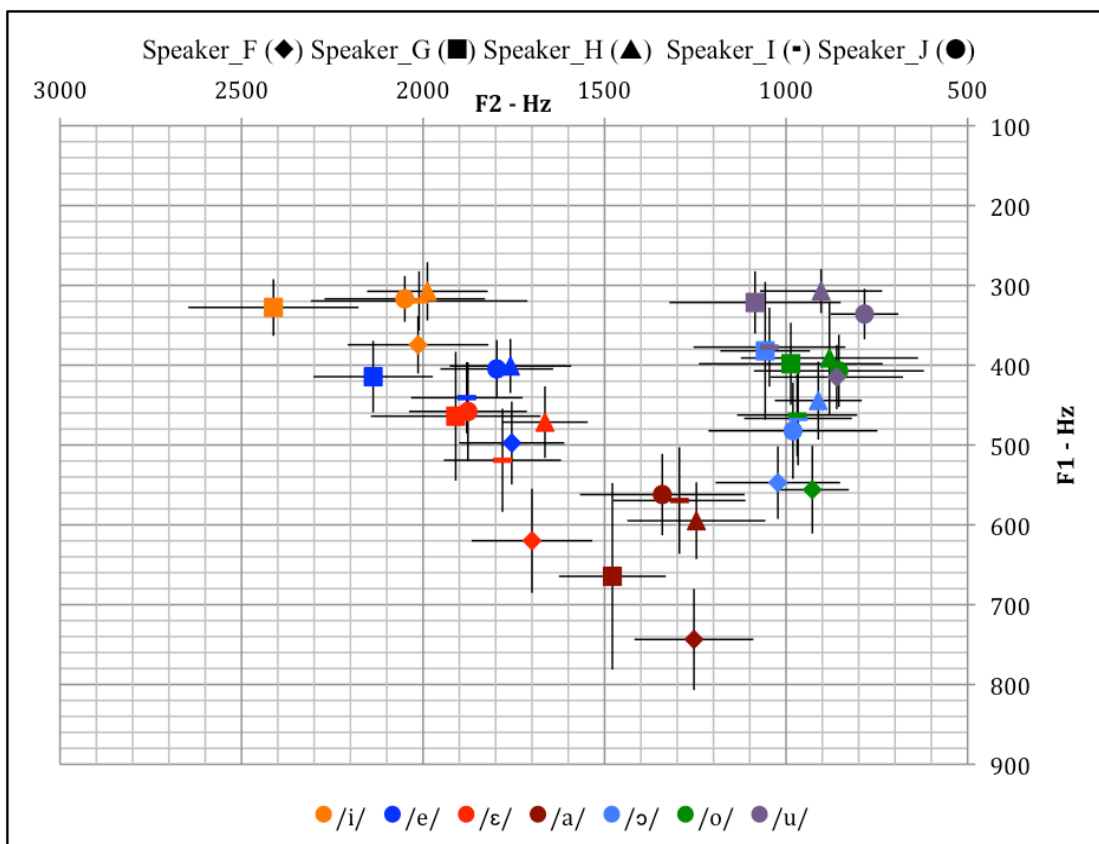


Figure 4.21. Male speakers: Mean F1 and F2 values and standard deviations for French mid-vowels with reference vowels.

Non-normalised F1 and F2 values for tokens of the mid- and reference vowels produced by female speakers are presented in Figure 4.22. A degree of overlap is evident between the reference vowels and the mid-vowels but, as for the male speakers, the position of the vowels relative to each other conforms largely to the schematised vowel space presented in Figure 4.19. There is a striking amount of overlap between /o/ and the reference vowel /u/ when all female speakers are considered together. Figure 4.23 presents the mean F1 and F2 values and standard deviations for vowels produced by individual female speakers. In the front of the vowel space, all speakers exhibit separation between the mid-vowels, /e/ and /ɛ/, and the low reference vowel /a/ but three speakers (B, D and E) show varying degrees of overlap between the close-mid vowel /e/ and the high front reference vowel /i/. Likewise, in the back of the vowel space, all speakers show separate distributions between the mid-vowels and the low reference vowel /a/ but four speakers (all except Speaker B) exhibit overlap with the high back reference vowel /u/. In two of these cases (Speakers C and E), overlap is also evident between the distributions of the open-mid vowel /ɔ/ and the reference vowel /u/.

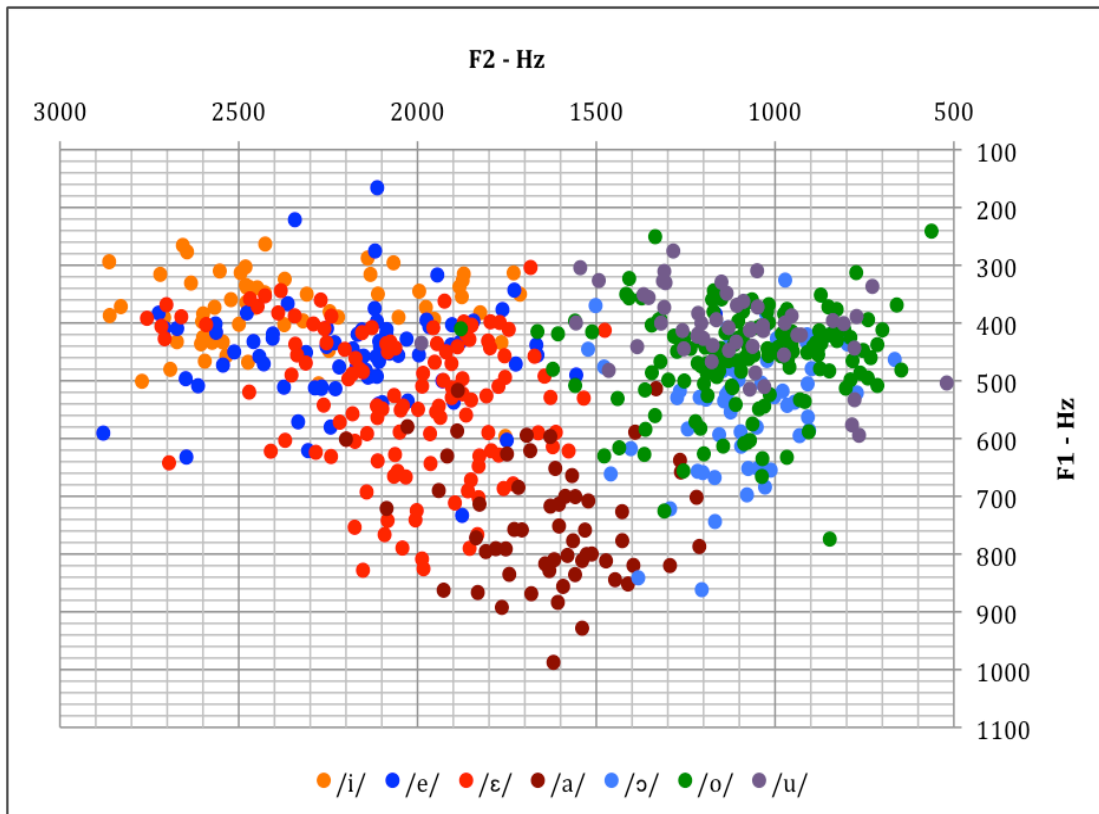


Figure 4.22. Female speakers: F1 and F2 values for French mid-vowels with reference vowels.

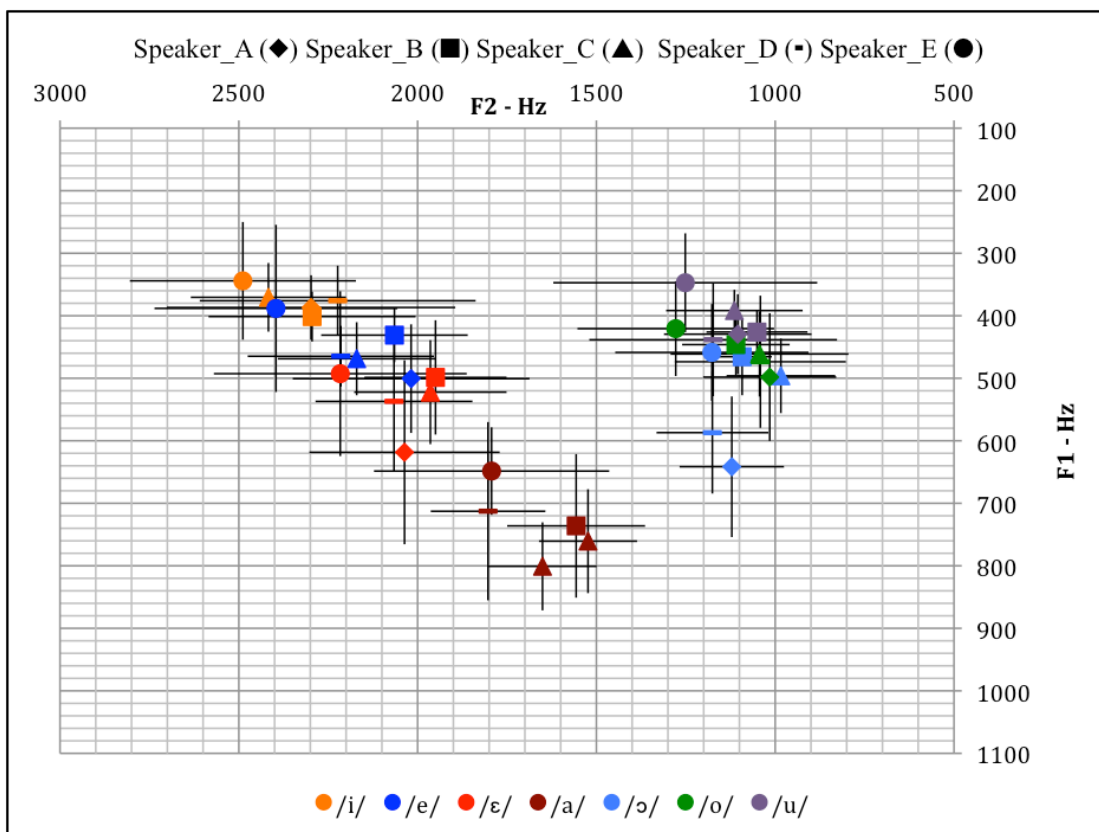


Figure 4.23. Female speakers: Mean F1 and F2 values and standard deviations for French mid-vowels with reference vowels.

4.3.1 FRENCH FRONT MID-VOWELS

The SF distinction between the front mid-vowels is one of vowel height with /e/ and /ɛ/ occupying close-mid and open-mid positions respectively within the vowel space. The non-normalised tokens of the male speakers' front mid-vowels, plotted in Figure 4.20, show that there is a general tendency for tokens of /ɛ/ to be lower and centralised relative to /e/ but that there are overlapping tokens in their distributions on both the F1 and F2 dimensions.

Figure 4.21 presents the means and standard deviations for individual male speakers. Speaker F is the only speaker to show complete separation on the F1 dimension between the front mid-vowels and, as such, conforms to the SF norm. For all other male speakers, varying degrees of overlap are evident between the front mid-vowels for both vowel height and vowel frontness/backness. With the exception of Speaker J, all male speakers show a tendency for the mean data point for /ɛ/ to be lower and more centralised than that of /e/. Speaker J shows this tendency on the F1 dimension in that the mean value of /ɛ/ is lower than that of /e/ but the tendency on the F2 dimension is for /ɛ/ to be fronter than /e/. Overall, the standard deviations show that, with the exception of F1 for Speaker F, there is a lot of overlap between the front mid-vowels, /e/ and /ɛ/, for both vowel height and vowel frontness/backness, suggesting that these tendencies are most likely non-significant for these speakers in making a phonetic distinction between the vowels.

Non-normalised tokens of the front mid-vowels are plotted in Figure 4.22 for all female speakers. There are more tokens of /ɛ/ than of /e/ in the open area of the

mid-vowel space but when all female speakers are considered together there is overlap evident between the front mid-vowels on both the F1 and F2 dimensions.

Figure 4.23 provides the mean F1 and F2 values and standard deviations for /e/ and /ɛ/ for each of the five female speakers individually. All speakers exhibit overlap between /e/ and /ɛ/ on both the F1 and F2 dimensions but, with the exception of Speaker A, they show a tendency for the mean value of /ɛ/ to be lower and centralised relative to the mean value for /e/. We have witnessed this pattern of distinguishing between /e/ and /ɛ/ using variations in both vowel height and vowel frontness/backness in the male data set above and in the Béarnais data for (some) female and male speakers. Again, the variation around the means shown in Figure 4.23 suggests that this tendency towards opening and backing of /ɛ/ does not consistently separate it from /e/ for female speakers. Speaker A does not show any separation between the distributions of the front mid-vowels on the F2 dimension but exhibits incomplete separation between their distributions on the F1 dimension.

4.3.1.1 MODELLING THE FRENCH FRONT MID-VOWELS

This section presents the statistical analysis of the French front mid-vowels focusing on two dependent variables: F1 and F2. As before, these dependent variables are continuous and modelled using mixed-effects linear regression. The regression analyses of F1 and F2 all include ‘speaker’ and ‘word’ as random effects. The fixed effect factor groups included in the analyses are summarised in Table 4.58. The inclusion of the ‘syllable type’ factor group aims explicitly to examine the use of the *loi de position* in the older speakers’ variety of French comparing the phonetic

realisations of vowels in open syllables to those in closed syllables. The remaining factor groups are the same as those included in the analysis of the Béarnais mid-vowels (Table 4.2).

Factor Group	Factors	Example
Phoneme	/e/	<i>arrêté</i>
	/ɛ/	<i>étais</i>
Syllable Type	/Cv#/- Open final	<i>étais</i>
	/CvC#/- Closed final	<i>frère</i>
	/vCV(C)#/- Open medial	<i>débat.</i>
Lexical Frequency	Continuous variable: logarithmic function of lexical frequency/per million words	-
F1	Continuous variable	-
F2	Continuous variable	-
Speaker sex	Male	-
	Female	-

Table 4.58. Factors groups and factors included in statistical analyses of the French mid-vowels.

The regression model for F1, built using normalised data from both male and female speakers, is provided in Table 4.59. Three significant effects are included as predictors of F1 values: syllable type ($p \leq 0.01$); phoneme ($p \leq 0.01$); F2 ($p \leq 0.01$). Speaker sex and lexical frequency were returned by the model as non-significant predictors. There is a highly significant correlation between syllable type and the value of F1: closed syllables favour high F1 values while open syllables favour low F1 values. The magnitude of this effect is relatively large. This shows that open vowels are present in closed syllables and that close vowels are present in open syllables or that the *loi de position* is used by older speakers. The effect is also returned as significant by models considering male ($p = 1.87e-13$) and female ($p = 2.94e-08$) speakers separately. The separate regression models for male and

female speakers can be consulted in Appendix 4B. The effect of ‘phoneme’ is also returned by the regression analysis as a highly significant predictor of F1: /ε/ favours high F1 values; /e/ favours lower F1 values. Therefore, /ε/ is significantly lower in the vowel space than /e/. This vowel height distinction conforms to the prescriptive norm. The examination of the raw data for male and female speakers revealed that varying degrees of F1 separation were achieved between the means of the front mid-vowels but all speakers exhibited some overlap between the vowels. The regression models considering male and female speakers separately return ‘phoneme’ as a significant predictor of F1 but the probabilities are at the lower ($p \leq 0.05$) significance level. Finally, F2 is returned as a significant predictor of F1: there is a positive correlation between vowel frontness and vowel height. Fronter vowels are also significantly lower in the vowel space. This effect is not consistent with the raw data where there is a tendency for higher front mid-vowels to be further forward in the vowel space (see Figures 4.21 and 4.23).

Dependent variable = F1 N = 442 Grand mean = 0.095		Deviance: 753 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Syllable Type	/CvC#/	0.553	144	1.05-17
	/vCV(C)#/	-0.225	140	
	/Cv#/	-0.328	158	
Phoneme	/ε/	0.115	246	0.00380
	/e/	-0.155	196	
F2	Continuous variable	0.154	442	0.00528
Non-significant factor groups were Speaker sex ($p=0.356$) and Lexical frequency ($p=0.485$).				

Table 4.59. All speakers: Results of mixed-effects linear regression for F1 in the front mid-vowels.

The regression model for F2, including male and female speakers, is presented in Table 4.60. Two effects are returned as significant by the analysis: syllable type ($p \leq 0.01$); F1 ($p \leq 0.05$). Lexical frequency, speaker sex and phoneme were all returned as non-significant predictors of the variation observed. The non-significant effect for ‘phoneme’ means that the older speakers do not distinguish significantly between the front mid-vowels on the basis of F2. The significant effect included here for F1 ($p = 0.0146$) mirrors the positive correlation between vowel height and vowel frontness included in the F1 model above. Since this was not consistent with the analysis of the raw data, I will discuss only the significant effect returned for syllable type here. The correlation between syllable type and F2 is very highly significant ($p = 1.86e-06$). The regression model shows that open syllables favour high F2 values and that closed syllables favour low F2 values. This shows that open syllables contain fronter vowels than closed syllables. It seems that, for older speakers, the *loi de position* should be extended to include close front vowels in open syllables and open centralised vowels in closed syllables. When male and female speakers are considered separately, this modified *loi de position* is also true for female speakers ($p = 4.91e-06$) but not for male speakers, for whom no significant predictors of F2 are returned by the regression model. The individual models for male and female speakers are included in Appendix 4B. In the analysis of the raw data, we observed that the dominant pattern for female speakers involved lower centralised variants of /ɛ/ relative to /e/. Given that ‘phoneme’ is not returned as a significant predictor of F2, it is more likely that this front/centralised variation is governed by syllable type rather than by a phonemic distinction. This suggests that while phonemic distinctions, such as ‘j’irai’ /e/ - ‘j’irais’ /ɛ/, are not made on the

basis of F2, phonetic distinctions, such as ‘j’irai/j’irais’ [e] – ‘arrête’ [ɛ], are realised in open and closed syllables respectively.

Dependent variable = F2 N = 442 Grand mean = 0.785		Deviance: 617 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/Cv#/	0.161	158	1.86e-06
	/vCV(C)#/	0.076	140	
	/CvC#/	-0.237	144	
F1	Continuous variable	0.104	442	0.0146
Non-significant factor groups were Lexical frequency (p=0.309), Speaker sex (p=0.345), and Phoneme (p=0.906).				

Table 4.60. All speakers: Results of mixed-effects linear regression for F2 in the front mid-vowels.

As for the Béarnais front mid-vowels, a regression analysis was undertaken for vowel duration in the French front mid-vowels (including ‘speaker’ and ‘word’ as random effects and ‘phoneme’ as a fixed effect factor group). The results of this analysis showed that vowel length is not used contrastively to distinguish between French /e/ and /ɛ/ (p=0.0645) by older speakers.

4.3.2 FRENCH BACK MID-VOWELS

This section will examine acoustic data for the French back mid-vowels, /o/ and /ɔ/, traditionally distinguished in SF by vowel height. The raw data for male speakers are plotted in Figure 4.20. Considering all male speakers together, the back mid-vowels are not distinguished on the F1 or F2 dimensions.

Figure 4.21 presents the mean F1 and F2 values and standard deviations for /o/ and /ɔ/. The male speakers’ phonetic realisations of the back mid-vowels are tightly clustered together; a similar distribution was evident for the single Béarnais

/ɔ/ vowel (see Figure 4.3). Three speakers show extremely similar F1 values for their /o/ and /ɔ/ vowels (Speakers F, G and I) and exhibit only minimal mean F2 separation on the frontness/backness dimension. These mean values and their associated standard deviations suggest that /o/ and /ɔ/ are not distinguished phonetically for these speakers. For Speaker I in particular, for whom the means and standard deviations of /o/ and /ɔ/ overlap, it seems that a single phonetic category is used for both vowels. The other two speakers (Speakers H and J) exhibit similar F2 values for the back mid-vowels but show a tendency towards lower /ɔ/ vowels relative to /o/. Speaker J shows the greatest mean separation in vowel height between the back mid-vowels of the two but the corresponding F1 standard deviations suggest that, for both speakers, the height distinction is not consistently used to distinguish between /o/ and /ɔ/.

Figure 4.22 presents the raw data for all female speakers. As with male speakers, there is a high level of overlap between /o/ and /ɔ/ when all female speakers are considered together. Mean F1 and F2 values for the back mid-vowels are presented in Figure 4.23 for individual female speakers. The same two patterns witnessed in the male data emerge for female speakers: complete overlap between the /o/ and /ɔ/, or a tendency towards lower, centralised realisations of /ɔ/. Three speakers exhibit the first of these patterns (Speakers B, C and E) showing very little difference between the mean values for these vowels and a high degree of overlap between their distributions, suggesting as before that these speakers have a single phonetic category for the two SF vowels. Speakers A and D, on the other hand, show

a tendency towards lower centralised realisations of /ɔ/ but there is considerable overlap for both vowel height and vowel frontness/backness between the vowels for both speakers.

4.3.2.1 MODELLING THE FRENCH BACK MID-VOWELS

This section presents the results of the mixed-effects regression analyses of F1 and F2 in the back mid-vowels (/o/ and /ɔ/). All analyses include the same fixed effect factor groups as the analyses for the front mid-vowels (see Table 4.58) with the following adjustment: the ‘phoneme’ factor group includes /o/ and /ɔ/ as factors rather than, of course, /e/ and /ɛ/. All other fixed effects included in the analysis are the same.

The regression model for F1, including both male and female speakers, is provided in Table 4.61. Two predictors are returned as highly significant: syllable type ($p \leq 0.01$); F2 ($p \leq 0.01$). Lexical frequency, speaker sex and phoneme are all returned as non-significant. The non-significant result for ‘phoneme’ confirms that neither male nor female speakers make a significant vowel height distinction between /o/ and /ɔ/, the general pattern observed in the raw data. The very highly significant effect for syllable type confirms that the *loi de position* is used by all speakers for the back mid-vowels: closed syllables favour high F1 values (lower vowels) and open syllables favour low F1 values (higher vowels). The magnitude of this effect is relatively large and is comparable to the effect seen for the front mid-vowels (see Table 4.60). Regression models considering male and female speakers separately return the same pattern, the *loi de position*, as highly significant with probabilities of $p=1.78e-09$ and $p=6.5e-12$ respectively (see Appendix 4C). There is

also a highly significant correlation between F2 and F1: high F2 values (centralised vowels) predict high F1 values (low vowels). This mirrors the results returned by the regression analyses of the front mid-vowels (see Tables 4.59 and 4.60). We can investigate, in the analysis of F2, if this pattern is also linked to syllabic conditioning of vowel frontness/backness.

Dependent variable = F1 N = 432 Grand mean = -0.042		Deviance: 720 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C v C#/	0.503	150	5.66e-20
	/C v #/	-0.238	135	
	/v CV (C)#/	-0.265	147	
F2	Continuous variable	0.392	432	6.11e-12
Non-significant factor groups were Lexical frequency (p=0.12), Speaker sex (p=0.327), and Phoneme (p=0.729).				

Table 4.61. All speakers: Results of mixed-effects linear regression for F1 in the back mid-vowels.

Table 4.62 presents the regression model for F2 in the back mid-vowels. F1 ($p \leq 0.01$) and syllable type ($p \leq 0.01$) are returned as highly significant predictors of vowel frontness/backness. Lexical frequency, phoneme and speaker sex were returned as non-significant. The negative result for ‘phoneme’ confirms that, across speakers, the back mid-vowels are not distinguished phonetically on the basis of F2. The expected F1/F2 correlation, returned above in the model of vowel height, is again shown to be very highly significant: increases in F1 (lower vowels) predict increases in F2 (centralised vowels). Again, syllable type is returned as a highly significant predictor of F2: medial open syllables favour high F2 values while final syllables (both open and closed) favour low F2 values. This means that medial syllables predict centralised vowels while final syllables predict back vowels. The medial-final alternation differs from the pattern described above for the front mid-

vowels which involved alternations in open and closed syllables. This pattern is returned as highly significant for both male and female speakers by regression analyses considering the sexes separately (Appendix 4C).

Dependent variable = F2 N = 432 Grand mean = -0.889		Deviance: 571 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.282	432	9.04e-13
Syllable type	/vCV(C)#/	0.195	147	3.41e-06
	/Cv#/	-0.097	135	
	/CvC#/	-0.098	150	
Non-significant factor groups were Lexical frequency (p=0.0874), Phoneme (p=0.404), and Speaker sex (p=0.634).				

Table 4.62. All speakers: Results of mixed-effects linear regression for F2 in the back mid-vowels.

Finally, a regression analysis of vowel duration (controlling for ‘speaker’ and ‘word’) returned ‘phoneme’ as a significant predictor of the variation observed (p=0.0095): /o/ was shown to favour longer vowels than /ɔ/. This is consistent with Martinet’s claim that ‘c’est d’ordinaire la voyelle fermée qui est longue, et la voyelle ouverte qui est brève’ (1945:84). The regression coefficients for this effect are of low magnitude (± 0.007), suggesting that this effect is very small.

4.4 FRENCH NASAL VOWELS

The RF nasal vowels /ẽ œ ã õ/ involve complex non-linear interactions between three variable parameters: nasal consonant presence/absence; vowel nasalisation; vowel quality.

The presence or absence of a nasal consonant coda in addition to the nasal vowel is not lexically specified as it is in Béarnais. The presentation of the French

data in this section examines vowels in phonetically sequential and non-sequential nasal units separately since the different phonetic structures may affect the formant values of the vocalic elements (see Sections 3.3.2.3 and 3.3.3.2). This approach will also allow for direct comparison with the Béarnais data set in Section 4.5. The variable nature of the consonantal coda will be examined in Section 4.4.3.

Within these phonetically sequential and non-sequential nasal units, tokens are not sub-divided into categories for nasalised and non-nasalised vowels, as was the case for Béarnais. Auditory coding for nasalisation of each vowel was not possible given the large number of tokens that are included in the French data set. I chose to prioritise high token counts in order to elicit reliable statistical results rather than to apply subjective binary categories to the data set. The notation used here will always employ the nasal diacritic (̃) but this nasalisation should be assumed to be variable across vowels and across nasal units.

Figure 4.24 presents the four vocalic elements which occur in the French nasal units. In the front of the vowel space, /ẽ/ and /œ̃/ are distinguished by lip-rounding. In the back of the vowel space, /ā/ and /ɔ̃/ are distinguished in conservative varieties on the basis of vowel height and lip-rounding although we have seen evidence to suggest that, in Parisian French, the back nasal vowels are distinguished largely on the basis of lip-rounding alone (cf. Hansen, 1998). The discussion of vowel quality focuses on the general position of the vowels in the vowel space in terms of the first two formant frequencies. I also examine the extent to which the /ẽ/-/œ̃/ and /ā/-/ɔ̃/ pairs are distinguished on the basis of F1, F2 and, in Section 4.4.2, on the basis of F3.

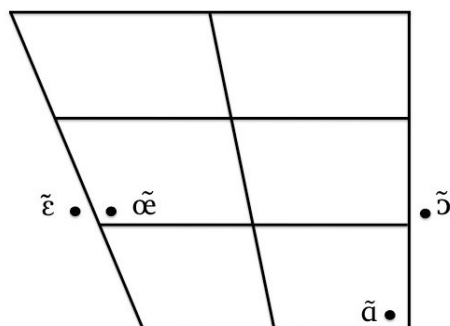


Figure 4.24. French nasal vowels.

Table 4.63 presents the token counts of the French nasal units dividing the data set into phonetically sequential and non-sequential units. Overall, there is a strong tendency for these older speakers to realise the nasal units with nasal consonant codas. The table shows that there are more nasal units produced with nasal consonants than without for all speakers and for all units. For some nasal units, certain individuals are categorical in the use of nasal consonant codas. The lower number of token counts for /œ̃/ is due to the low type frequency of the nasal vowel, occurring primarily in the high frequency word ‘un’ and derivatives thereof, e.g. ‘quelqu’un’, ‘chacun’ etc., as well as the fact that it is restricted phonotactically, occurring primarily in word final open syllables. /œ̃/ may also occur in open medial syllables (/ṽCV(C)#/), e.g. ‘lundi’, and in final closed syllables (/CṽC#/), e.g. ‘j’emprunte’, but these occurrences are extremely rare.

Sex	Speaker	/ɛ̃/		/œ̃/		/ã/		/õ/	
		[ɛ̃N]	[ɛ̃]	[œ̃N]	[œ̃]	[ãN]	[ã]	[õN]	[õ]
F	A	24	11	9	5	34	8	30	12
	B	15	14	8	7	24	14	22	16
	C	26	7	9	8	32	13	27	18
	D	38	6	14	2	37	4	30	13
	E	35	6	15	1	28	13	26	5
M	F	25	8	16	0	46	3	37	4
	G	23	11	12	4	18	16	31	6
	H	27	5	13	1	43	1	43	0
	I	24	10	14	1	40	5	31	8
	J	28	8	14	1	40	1	40	0
Total		265	86	124	30	342	78	317	82

Table 4.63. All speakers: Token counts for French nasal units by speaker (F = female; M = male).

4.4.1 VOWELS IN NASAL UNITS

This section focuses on vowel quality by examining F1 and F2 values for the vocalic elements in the French nasal units. The nasal units are presented separately for sequential and non-sequential units. This section aims to examine the general placement of the vowels relative to each other within the vowel space as well as the effect of different phonetic structures on the position of the vowels relative to each other.

Figure 4.25 presents the male speakers' F1 and F2 values for all vowels in sequential units. The position of the vowels relative to each other within the vowel space conforms largely to the schematised vowel space presented in Figure 4.24 above, with the exception of [ãN], which is centralised relative to [õN] and exhibits a degree of overlap with the front nasal vowels, [ɛ̃N] and [œ̃N]. There is a tendency

for tokens of [œN] to have lower F2 values than tokens of [ɛN], causing it to overlap with [ɔN], but the distributions of the front vowels exhibit a high degree of overlap. When all speakers are considered together, overlap is evident between all four vowels on the F1 and F2 dimensions though this may be a manifestation of inter-speaker variation.

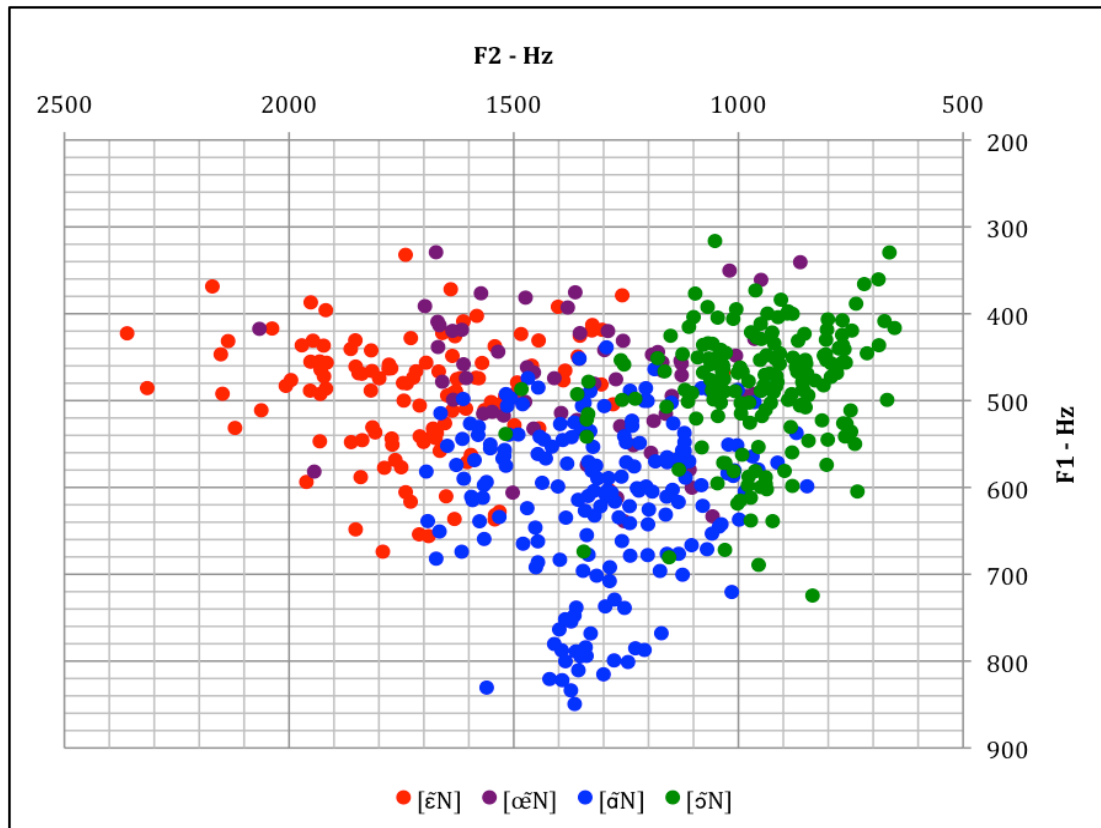


Figure 4.25. Male speakers: F1 and F2 values for French vowels in sequential [ṽN] nasal units.

The mean F1 and F2 values and standard deviations for the vowels in sequential units are plotted in Figure 4.26 for individual male speakers. The mean F2 values for [ɛN] and [œN] are separate for all speakers: F2 lowering is a common acoustic consequence of lip-rounding. Only three speakers (F, H and I) exhibit full separation on the F2 dimension between the front nasal vowels. Speaker G exhibits a small amount of F2 overlap while Speaker J produces completely overlapping distributions. With the exception of Speaker J, male speakers appear to retain a four-

term system in sequential units while Speaker J uses a three-term system more akin to supralocal French. [ãN] and [õN] are distinguished by all male speakers on the basis of vowel height and vowel frontness/backness. There is no overlap evident between the distributions of [ãN] and [õN] when individual speakers are considered separately. Speakers G, H and I produced [œN] tokens that overlap on the F2 dimension with [õN]. Speakers F and J do not exhibit such overlap. It is possible, for the speakers showing overlap between [œN] and [õN], that these vowels are distinguished more robustly on the basis of F3. This possibility will be investigated in Section 4.4.2. All other combinations of vowels are separate from each other when male speakers are considered individually. It is also striking that there is more inter-speaker variability evident for the front vowels that for the back vowels.

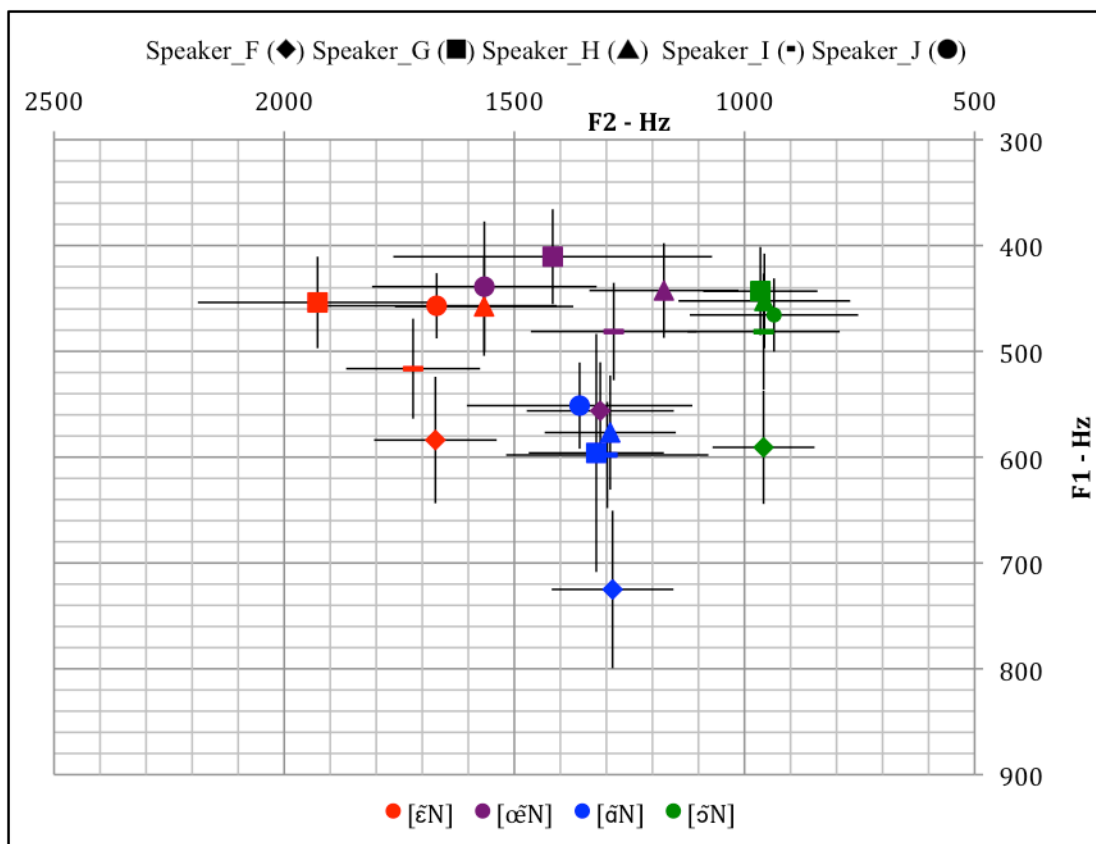


Figure 4.26. Male speakers: Mean F1 and F2 values with standard deviations for French vowels in sequential [ṽN] nasal units.

Figure 4.27 presents the vowel tokens in non-sequential units for male speakers. Once again, the placement of the vowels relative to each other conforms to the schematised vowel space. Overlap is evident between [ã] and all other vowels and between the front nasal vowels [ẽ] and [œ]. There are a smaller number of tokens in non-sequential units, particularly for [œ], which makes generalisation difficult.

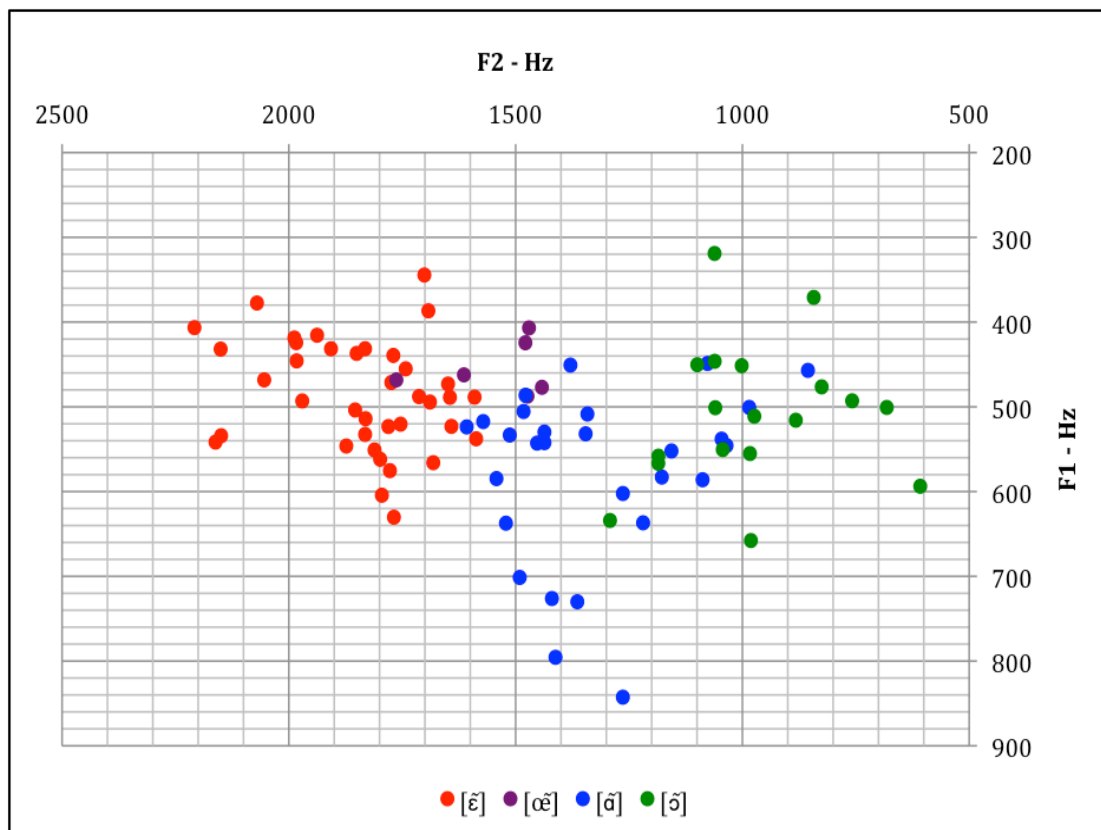


Figure 4.27. Male speakers: F1 and F2 values for French vowels in non-sequential [ṽ] nasal units.

The mean F1 and F2 values and standard deviations for each speaker for the vowels in non-sequential nasal units are plotted in Figure 4.28. Data points with no standard deviation represent one token, for example, the data points for [ã] for Speakers H and J. The absence of data points for certain speakers makes comparison with the sequential units difficult. We can, however, make the following observation: for the front nasal vowels, Speakers G, I and J exhibit separation between [ẽ] and

[œ̃] but this is based on only one [œ̃] data point for both Speaker I and Speaker J. Speakers F and H do not have data points for [œ̃] because they always produce a consonantal coda with the /œ̃/ nasal unit. The same is true of /ɔ̃/ for Speakers H and J. For the back nasal vowels, Speaker F and Speaker G exhibit separation between [ɑ̃N] and [ɔ̃N] but Speaker I has completely overlapping distributions for these vowels. Overall, the tendency for nasal units to be sequential obscures any differential patterning in vowel quality that may be evident in nasal units with and without consonantal codas. We will explore this question further in the statistical analysis.

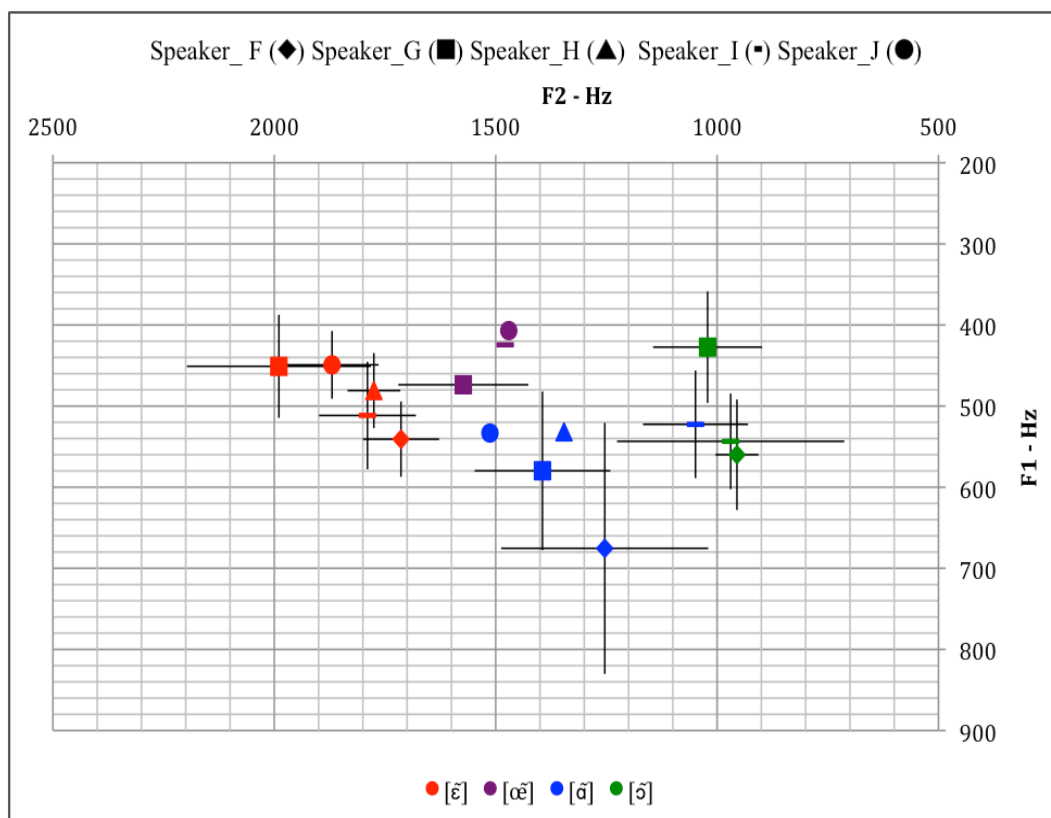


Figure 4.28. Male speakers: Mean F1 and F2 values with standard deviations for French vowels in non-sequential [ṽ] nasal units.

The F1 and F2 values for all vowels produced in sequential units by female speakers are plotted in Figure 4.29. While the general position of the vowels conforms to that

of the schematised vowel plot, the levels of dispersion of and overlap between the vowels is notably greater for female speakers than for male speakers (see Figure 4.25). The distributions of [ɛ̃N] and [œ̃N] are completely overlapping and [ɑ̃N] is clearly centralised relative to [ɔ̃N].

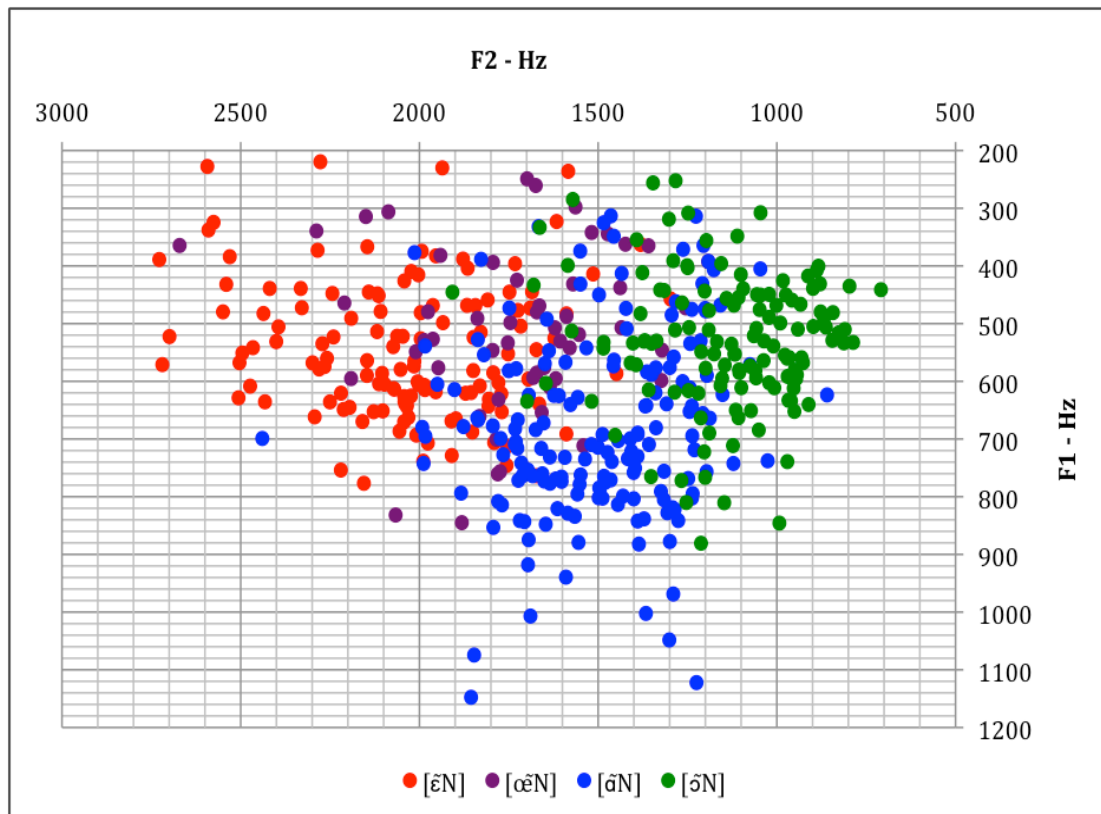


Figure 4.29. Female speakers: F1 and F2 values for French vowels in sequential [ṽN] nasal units.

The mean F1 and F2 values and standard deviations for the vowels in sequential units are plotted in Figure 4.30 for individual female speakers. In the front of the vowel space, all speakers show separation between the mean values of [ɛ̃N] and [œ̃N] but with varying amounts of F1 and F2 overlap between their distributions. F1 values tend to be similar for [ɛ̃N] and [œ̃N] across speakers and F2 overlap is evident for all speakers, with the exception of Speaker C. The front nasal vowels are more ‘merged’ than was the case for male speakers, which may be due to less lip-

rounding and consequently less F2-lowering. In the back of the vowel space, Speakers A, C and D show a relatively high degree of separation between the distributions of [ãN] and [ɔ̃N]. There is some vowel height overlap for these speakers but the distributions are completely separate on the front/back dimension. Speaker B and Speaker E show overlapping F2 values for [ãN] and [ɔ̃N] with Speaker B having a large F1 range for [ãN] which results in a high level of overlap with both [œ̃N] and [ɔ̃N]. In fact, all speakers with the exception of Speaker A exhibit overlap between the distributions of [œ̃N] and [ãN] due to the encroachment of tokens for [ãN] on the centre of the vowel space.

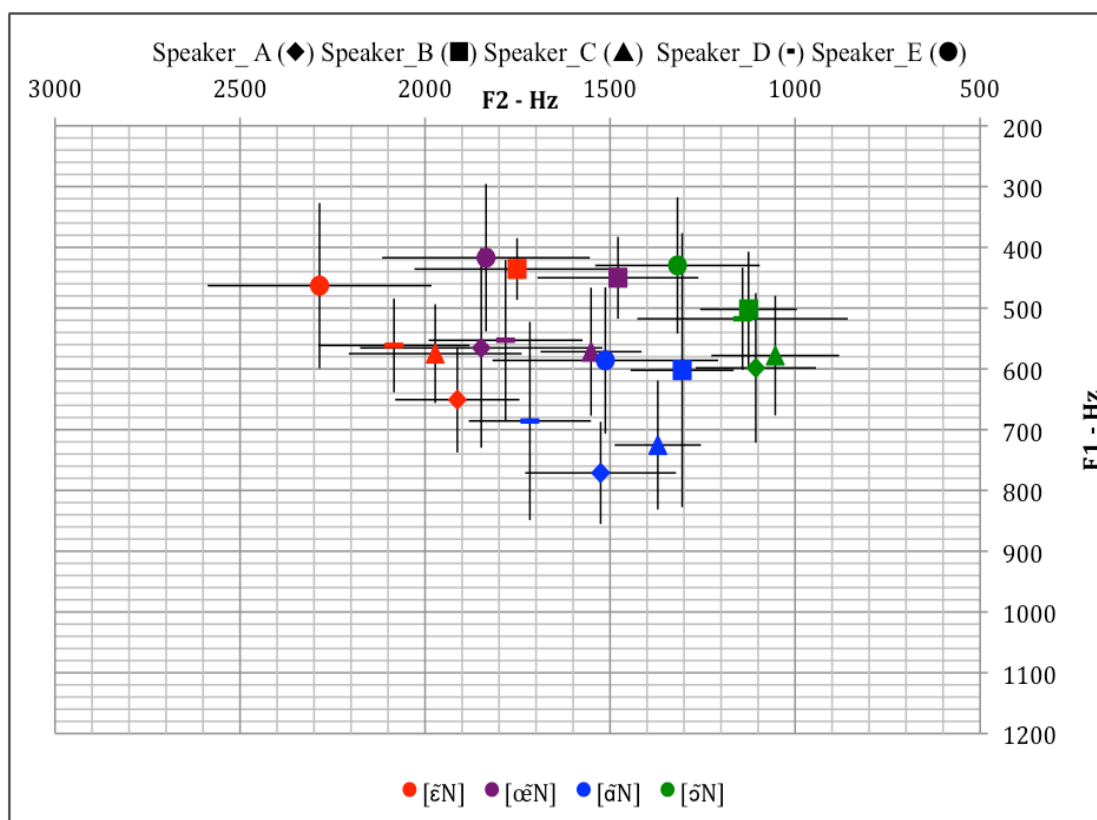


Figure 4.30. Female speakers: Mean F1 and F2 values with standard deviations for French vowels in sequential [ṽN] nasal units.

Figure 4.31 presents the vowel tokens in sequential nasal units for female speakers.

We may note that there are a higher number of sequential units for male speakers

than for female speakers (see Table 4.63). That is, female speakers tend to use less non-standard consonantal codas in nasal units than men. Again, there is a high degree of overlap between all of the nasal vowels: [ɛ̃] and [œ̃] show a tendency towards more separation than for sequential units but there is still substantial overlap between their distributions; [ã] encroaches on the mid-vowel space and exhibits overlap with all other vowels, as was the case for male speakers (see Figure 4.27).

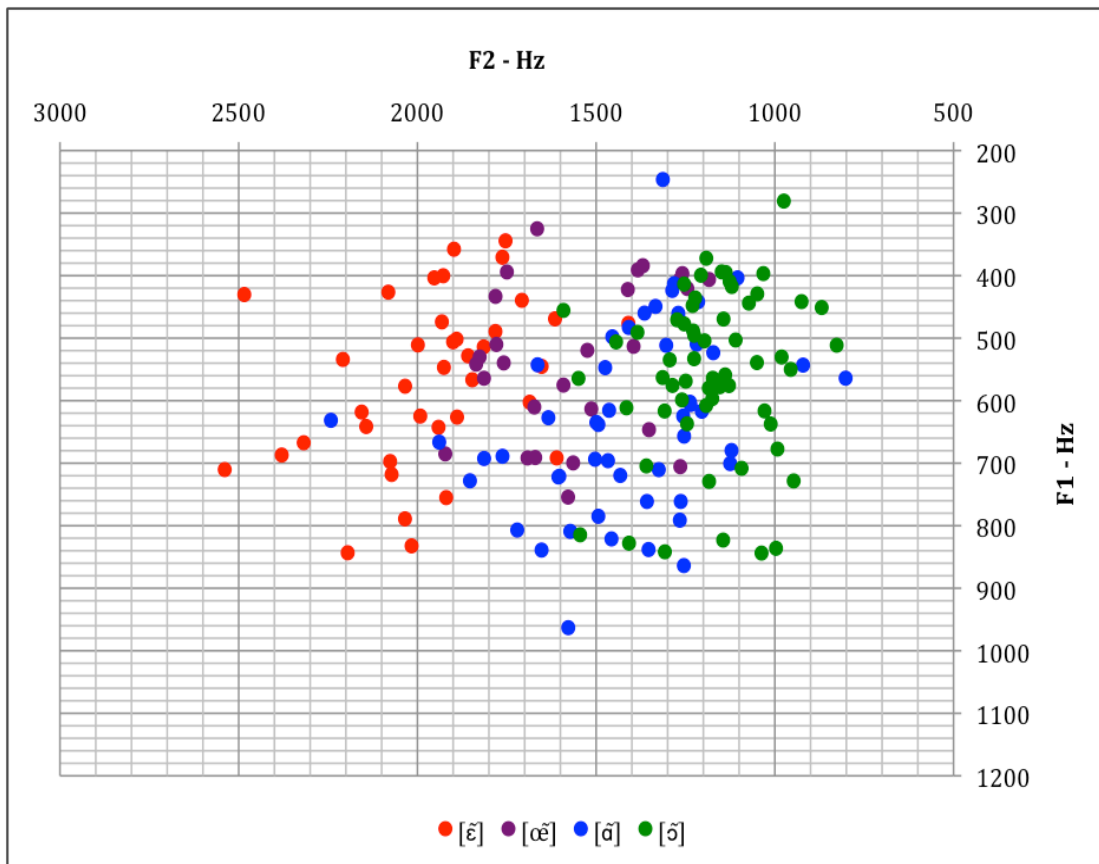


Figure 4.31. Female speakers: F1 and F2 values for French vowels in non-sequential [ṽ] nasal units.

The mean F1 and F2 values and standard deviations for vowels in non-sequential units are presented in Figure 4.32. In the front of the vowel space, all speakers except Speaker A exhibit complete separation on the F2 dimension between [ɛ̃] and [œ̃]. The majority pattern in the sequential units was to have overlapping F2 distributions. It seems to be the case that less of a distinction is made phonetically

between [ɛ̃] and [œ̃] when a nasal consonant is present. Speaker A exhibits high degree of separation between the mean values of the front nasal vowels but exhibits minimal overlap on the F2 dimension. In the back of the vowel space, all speakers except Speaker D exhibit varying degrees of F1 and F2 overlap between [ɑ̃] and [ɔ̃]. Speaker D has completely separate means and distributions for [ɑ̃] and [ɔ̃]. Speakers A, C and E exhibit overlap between [œ̃] and [ɑ̃] due to the encroachment of [ɑ̃] on the central vowel space. Speaker A was the only speaker to not produce this pattern in the sequential unit data set (see Figure 4.30).

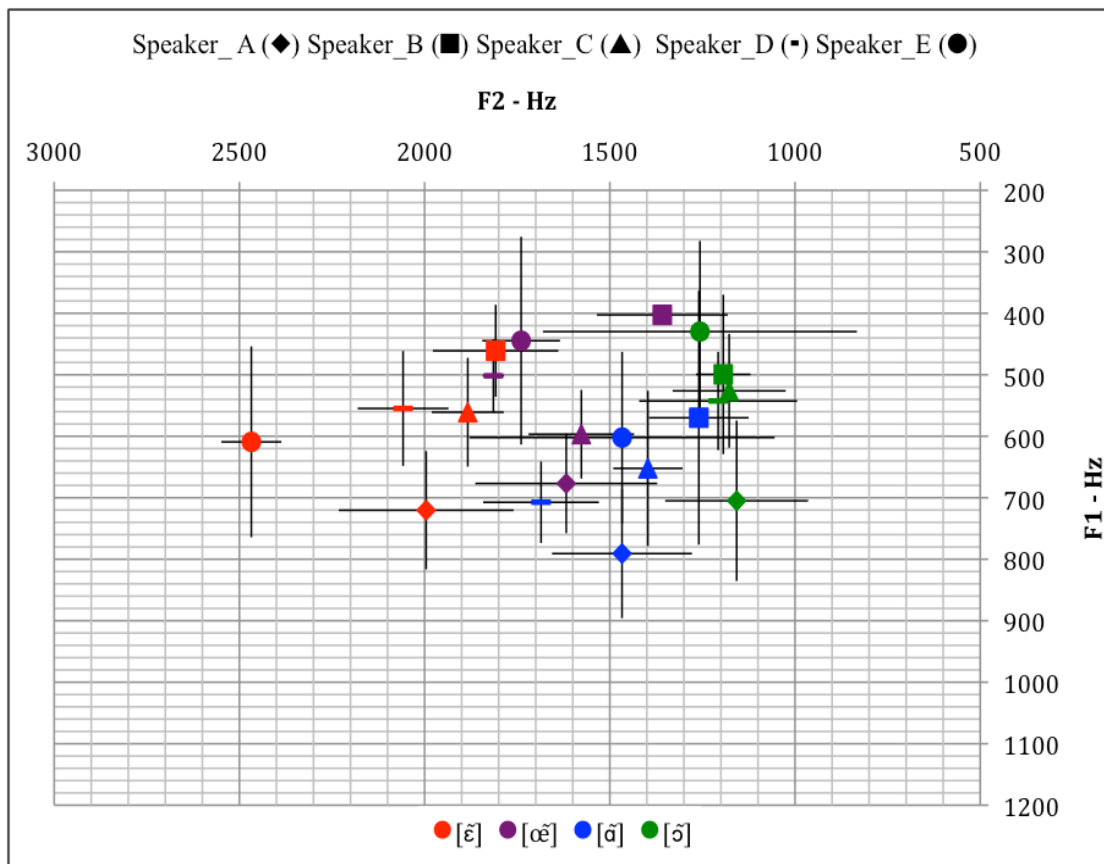


Figure 4.32. Female speakers: Mean F1 and F2 values and standard deviations for French vowels in non-sequential [ṽ] nasal units.

4.4.1.1 MODELLING SEQUENTIAL NASAL UNITS

This section models the sequential French nasal units statistically using mixed-effects linear regression models to examine the effect of the predictors presented in Table 4.64 on vowel quality (in terms of F1 and F2). ‘Speaker’ and ‘word’ are included in all models as random effects. Within each section, distinctions made on the basis of F1 and F2 between the front and back nasal vowel pairs /*ẽ*/-/*œ*/ and /*ã*/-/*õ*/ will be modelled statistically to examine the ability of the historically appropriate phoneme to predict the F1 and F2 values observed.

Factor Group	Factors	Example
Syllable Type	/C $\tilde{v}$ #/ – Final open syllables	<i>grand</i>
	/ $\tilde{v}$ CV(C)#/ – Medial open syllables	<i><u>con</u>tent</i>
	/C $\tilde{v}$ C#/ – Final closed syllables	<i>grande</i> ³⁷
Lexical Frequency	Continuous variable: logarithmic function of lexical frequency/per million words	-
(F1)	Continuous variable	-
(F2)	Continuous variable	-
Speaker sex	Male	-
	Female	-

Table 4.64. Factors groups and factors included in statistical analyses of the nasal units (F1 and F2 as dependent variables).

The regression model of F1 values for /*ẽ*/ in sequential nasal units is provided in Table 4.65 for all speakers. Two fixed effects are returned by the analysis as significant predictors of F1: syllable type ($p \leq 0.01$) and F2 ($p \leq 0.01$). Speaker sex and lexical frequency are not returned as significant predictors of the variation observed. The regression coefficients for syllable type show that final open

³⁷ Final closed syllables may be followed, in RF, by a variable post-tonic schwa (pseudo-closed syllables).

and closed syllables favour relatively higher F1 values while medial (open) syllables are favour low F1 values. This shows that [ɛ̃N] occurring in final syllables is more open than [ɛ̃N] occurring in medial syllables, where closer vowels are predicted by the model. This pattern is returned by the model as highly significant. F2 is also returned as a highly significant predictor of F1 and the two are positively correlated. This means that increases in F2 predict increases in F1 which may be interpreted as vowel fronting entailing vowel lowering. This relationship may be due to lingual configuration but, equally, nasal coupling could govern this correlation in that velar aperture can result in the lowering of both F1 and F2.

Nasal Unit = [ɛ̃N] Dependent variable = F1 N = 265 Grand mean = -0.303		Deviance: 537 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable Type	/C $\tilde{\nu}$ #/	0.190	98	0.000282
	/C $\tilde{\nu}$ C#/	0.109	65	
	/ $\tilde{\nu}$ CV(C)#/	-0.299	102	
F2	Continuous variable	0.144	265	0.00988
Non-significant factor groups: Speaker sex (p=0.0915) and Lexical frequency (p=0.293).				

Table 4.65. All speakers: Results of mixed-effects linear regression for F1 in [ɛ̃N].

The regression model for F2 is presented in Table 4.66. Only F1 is returned by the analysis as a significant predictor of the value of F2 for /ɛ̃/ in sequential nasal units. This is the same positive correlation between F1 and F2 as seen in the F1 model above with a similar magnitude and significance value ($p \leq 0.01$): increases in F1 predict increases in F2. Lexical frequency, syllable type and speaker sex were all excluded from the model of F2 by the analysis.

Nasal Unit = [ɛ̃N] Dependent variable = F2 N = 265 Grand mean = 1.04		Deviance: 579 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.179	265	0.0064
Non-significant factor groups : Lexical frequency (p=0.203), Syllable type (p=0.464) and Speaker sex (p=0.763).				

Table 4.66. All speakers: Results of mixed-effects linear regression for F2 in [ɛ̃N].

Turning now to the front rounded vowel /œ̃/ in sequential units, the results of the regression analysis are presented in Table 4.67 for F1. Speaker sex is returned as the only significant predictor ($p \leq 0.01$): female speakers favour higher F1 values for [œ̃N] than male speakers. Models considering male and female speakers separately return no significant predictors for F1. Syllable type, lexical frequency and F2 are all returned by the composite model as non-significant. In the case of syllable type, the vast majority of variants are in final open syllables (/Cṽ#/), with only three variants in medial open syllables (/ṽCV(C)#/) and no variants in final closed syllables (/CṽC#/). The regression model for F2 is presented in Table 4.68 for [œ̃N]: no fixed effects are returned as significant predictors.

Nasal Unit = [œ̃N] Dependent variable = F1 N = 124 Grand mean = -0.631		Deviance: 316 Degrees of freedom: 8		
Factor Group	Factor	Coeff.	N	P-value
Speaker sex	Female	0.168	55	0.038
	Male	-0.168	69	
Non-significant factor groups were Syllable type (p=0.256), Lexical frequency (p=0.324), and F2 (p=0.885).				

Table 4.67. All speakers: Results of mixed-effects linear regression for F1 in [œ̃N].

Nasal Unit = [œ̃N] Dependent variable = F2 N = 124 Grand mean = 0.171	Deviance: 234 Degrees of freedom: 8
Non-significant factor groups were Syllable type (p=0.063), Speaker sex (p=0.16), Lexical frequency (p=0.343), and F1 (p=0.709).	

Table 4.68. All speakers: Results of mixed-effects linear regression for F2 in [œ̃N].

To examine the difference in F1 values for the front nasal vowels, /ẽ/ and /œ̃/, in sequential units, which are attested to be completely merged in supralocal French, a regression model of F1 considering phoneme and speaker sex as fixed effects is presented in Table 4.69. Phoneme is returned by the model as non-significant confirming that, when all speakers are considered together, there is no significant difference between the F1 values realised for the historically appropriate phonemes /ẽ/ and /œ̃/ in sequential nasal units. The interaction between phonemic identity and speaker sex is equally returned as non-significant. Speaker sex is returned by the model as significant ($p \leq 0.05$). Regression models for male and female speakers are presented separately in Tables 4.70 and 4.71 respectively. For male speakers, phoneme is returned as a significant predictor of F1 ($p \leq 0.05$): /ẽ/ favours high F1 values while /œ̃/ favours low F1 values. This shows that a significant phonetic distinction is made by male speakers on the basis of F1 between /ẽ/ and /œ̃/ in sequential units. The magnitude of this effect is relatively large. In the regression model of F1 for female speakers, no significant predictors are returned. This shows that female speakers do not make a significant phonetic distinction between /ẽ/ and /œ̃/ on the basis of F1 ($p = 0.831$).

Nasal Unit = [ɛ̃N œ̃N] Dependent variable = F1 N = 389 Grand mean = -0.408		Deviance: 893 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Sex	Female	0.122	193	0.0114
	Male	-0.122	196	
Non-significant factor groups were Phoneme (p=0.34) and Sex*Phoneme (p=0.129).				

Table 4.69. All speakers: Results of mixed-effects linear regression for F1 in [ɛ̃N œ̃N].

Nasal Unit = [ɛ̃N œ̃N] Dependent variable = F1 N = 196 Grand mean = -0.51		Deviance: 440 Degrees of freedom: 5		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ɛ̃/	0.218	127	0.0167
	/œ̃/	-0.218	69	

Table 4.70. Male speakers: Results of mixed-effects linear regression for F1 in [ɛ̃N œ̃N].

Nasal Unit = [ɛ̃N œ̃N] Dependent variable = F1 N = 193 Grand mean = -0.304	Deviance: 455 Degrees of freedom: 5
Non-significant factor groups were Phoneme (p=0.831).	

Table 4.71. Female speakers: Results of mixed-effects linear regression for F1 in [ɛ̃N œ̃N].

Table 4.72 presents the regression model of F2 values for the front nasal vowels considering phoneme and speaker sex as fixed effects. Since F2 lowering is a common acoustic consequence of lip-rounding, we would expect F2 to be significantly different for /ɛ̃/ and /œ̃/ if they are not merged. Phoneme is indeed returned by the analysis as a very highly significant predictor of F2: /ɛ̃/ favours relatively higher F2 values while /œ̃/ favours lower F2 values. The magnitude of this effect is large meaning that [ɛ̃N] is significantly fronter in acoustic space than

[œN]. This is most likely due to F2 lowering as a result of lip-rounding rather than lingual configuration. Speaker sex is not returned as a significant predictor of the F2 distribution but there is a significant interaction between speaker sex and phonemic identity ($p \leq 0.05$). There is a tendency for female speakers to realise /ẽ/ with a lower F2 value than male speakers and /œ/ with a higher F2 value than male speakers. This confirms that female speakers make less of a distinction between the phonemes on the basis of F2 when they occur in sequential units: [ẽN] and [œN] are closer together in acoustic space for female speakers.

Nasal Unit = [ɛ̃N œ̃N] Dependent variable = F2 N = 389 Grand mean = 0.763		Deviance: 837 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Sex*Phoneme	Female:/œ̃/	0.069	55	0.0181
	Male:/ɛ̃/	0.069	127	
	Female:/ɛ̃/	-0.069	138	
	Male:/œ̃/	-0.069	69	
Phoneme	/ɛ̃/	0.425	265	0.000176
	/œ̃/	-0.425	124	
Non-significant factor groups were Speaker sex (p=0.244).				

Table 4.72. All speakers: Results of mixed-effects linear regression for F2 in [ẽN œN].

Moving on to the back vowel phonemes, the model for F1 for the low nasal vowel /ã/ in sequential units is presented in Table 4.73 for all speakers. Two fixed effects are returned by the regression analysis as very highly significant: syllable type ($p \leq 0.01$) and F2 ($p \leq 0.01$). Speaker sex and lexical frequency are not shown to be significant predictors of F1. For syllable type, a similar pattern to that seen for

[ɛ̃N] (Table 4.65) emerges for [ãN]: final syllables favour high F1 values while medial syllables favour low F1 values. In articulatory terms, we might interpret this as a lower tongue configuration for vowels in word-final stressed position. The magnitude of this effect is also similar to that observed for [ɛ̃N] and the effect is very strong. F2 is positively correlated to F1 whereby high F2 values will predict high F1 values. It is possible, as noted previously, that this relationship is governed by the degree of nasalisation of the vowel as nasal coupling causes both F1 and F2 to be lower, rather than interpreting it in terms of lingual configuration (i.e. fronting and lowering).

Nasal Unit = [ãN] Dependent variable = F1 N = 342 Grand mean = 0.815		Deviance: 852 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C $\tilde{v}$ #/	0.163	101	0.000526
	/C $\tilde{v}$ C#/	0.125	109	
	/ $\tilde{v}$ CV(C)#/	-0.288	132	
F2	Continuous variable	0.258	342	0.00242
Non-significant factor groups were Speaker sex (p=0.0678) and Lexical frequency (p=0.497).				

Table 4.73. All speakers: Results of mixed-effects linear regression for F1 in [ãN].

The model for F2 in [ãN] is presented in Table 4.74 for all speakers where three fixed effects are returned as significant: F1 ($p \leq 0.01$), syllable type ($p \leq 0.05$) and lexical frequency ($p \leq 0.05$). The relationship between F1 raising and F2 raising described above for the F1 model is again returned as very highly significant. The effect of syllable type shows final syllables to favour low F2 values while medial syllables favour high F2 values. Overall the syllabic conditioning of the vowel in

[ãN] can be described as follows: final open and closed syllables favour high F1 values and low F2 values; medial (open) syllables favour low F1 values and high F2 values. Finally, lexical frequency is positively correlated with F2: more frequent words have acoustically ‘backer’ variants of [ãN] suggesting that variants occurring in more frequent words are more like the supralocal norm. We might assume that this ‘backing’ of the vowel in frequent words is due to tongue retraction but it may also be due to variations in lip-rounding and in nasopharyngeal aperture.

Nasal Unit = [ãN] Dependent variable = F2 N = 342 Grand mean = -0.023		Deviance: 550 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.098	342	0.00537
Syllable type	/ṽCV(C)#/	0.123	132	0.0227
	/Cṽ#/	-0.050	101	
	/CṽC#/	-0.073	109	
Lexical frequency	Continuous (log-transformed)	0.099	342	0.0355
Non-significant factor groups were Speaker sex (p=0.157).				

Table 4.74. All speakers: Results of mixed-effects linear regression for F2 in [ãN].

For the back open-mid nasal vowel in sequential units, the regression model for F1 is presented in Table 4.75. F2 and syllable type are returned by the analysis as very highly significant ($p \leq 0.01$). As for the other vowels in sequential units (with the exception of /œ/), there is a significant positive correlation between F2 and F1: high F2 values predict high F1 values which may be linked to the effect of nasal coupling. For syllable type, the regression coefficients show the pattern we have seen in the other nasal units (except /œ/): final (open and closed) syllables favour high F1

values while medial syllables favour low F1 values. The situation is more complicated for [ɔ̃N] in that the regression coefficient for final open syllables is relatively neutral with only final closed syllables favouring high F1 values. This suggests that final closed syllables contain significantly lower vowels than open medial syllables. Lexical frequency and speaker sex are not returned by the regression analysis as significant.

Nasal Unit = [ɔ̃N] Dependent variable = F1 N = 317 Grand mean = -0.379		Deviance: 662 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.249	317	0.000138
Syllable type	/Cɔ̃C#/	0.207	87	0.00172
	/Cɔ̃#/	0.082	106	
	/ɔ̃CV(C)#/	-0.289	124	
Non-significant factor groups were Lexical frequency (p=0.318) and Speaker sex (p=0.736).				

Table 4.75. All speakers: Results of mixed-effects linear regression for F1 in [ɔ̃N].

The regression model for F2 is presented in Table 4.76 whereby only the relationship between F1 and F2 is returned as significant. This effect is very highly significant and is described above in relation to the F1 model.

Nasal Unit = [ɔ̃N] Dependent variable = F2 N = 317 Grand mean = -0.979		Deviance: 544 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.031	317	0.000211
Non-significant factor groups were Syllable type (p=0.0882), Lexical frequency (p=0.58), and Speaker sex (p=0.671).				

Table 4.76. All speakers: Results of mixed-effects linear regression for F2 in [ɔ̃N].

Table 4.77 examines the relationship between the phonemic identity of /ã/ and /õ/ and F1 values since, as we have seen, there has been some indication that in Parisian French, the back nasal vowels are distinguished primarily on the basis of the feature [+round] which manifests itself acoustically as low values for F2 and F3. The model shows the F1 distinction between /ã/ and /õ/ to be highly significant ($p=1.05e-38$) with /ã/ favouring higher F1 values and /õ/ favouring low F1 values. This ties in with the expected placement of these vowels in articulatory space: /ã/ is realised as a significantly lower vowel than /õ/ in sequential nasal units. Speaker sex alone is returned by the model as non-significant but the significant sex*phoneme interaction term shows that female speakers realise higher vowels for /ã/ than male speakers and lower vowels for /õ/ than male speakers. This suggests that the separation between /ã/ and /õ/ is maximal for male speakers: there is less evidence, in the speech of male informants, for the gradual phonetic merger taking place in some varieties of supralocal French.

Nasal Unit = [ãN 5N] Dependent variable = F1 N = 659 Grand mean = 0.24		Deviance: 1581 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Sex*Phoneme	Female:/õ/	0.071	135	0.0242
	Male:/ã/	0.071	187	
	Female:/ã/	-0.071	155	
	Male:/õ/	-0.071	182	
Phoneme	/ã/	0.603	342	1.05e-38
	/õ/	-0.603	317	
Non-significant factor groups were Speaker sex (p=0.0829).				

Table 4.77. All speakers: Results of mixed-effects linear regression for F1 in [ãN ãN].

The relationship between F2 values and the phonemic identity of /ã/ and /õ/ in sequential nasal units is modelled statistically in Table 4.78. Phoneme is a highly significant predictor of F2 ($p=7.65e-55$): /ã/ favours significantly higher F2 values than /õ/. This shows that the vowels in /ã/ nasal units are both lower and fronter than the vowels in /õ/ nasal units, when a consonantal coda is present: the supralocal merger of /ã/ and /õ/ does not appear to be taking place in the older speakers' regional variety of French. Speaker sex and the sex*phoneme interaction term are not returned as significant.

Nasal Unit = [ãN ɔ̃N] Dependent variable = F2 N = 659 Grand mean = -0.483		Deviance: 1145 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.485	342	7.65e-55
	/ɔ̃/	-0.485	317	
Non-significant factor groups were Speaker sex (p=0.056) and Sex*Phoneme (p=0.0661).				

Table 4.78. All speakers: Results of mixed-effects linear regression for F2 in [ãN ɔ̃N].

The significant effects returned by the regression models for the sequential units can be summarised as follows: F1 and F2 are positively correlated for all vowels (except /œ/); final syllables favour higher F1 values than medial syllables; lexical frequency can significantly predict the frontness of /ã/ with more frequent lexical items containing more supralocal-like variants.

4.4.1.2 MODELLING NON-SEQUENTIAL NASAL UNITS

This section will present mixed-effects regression models for the nasal vowels occurring in non-sequential nasal units, when no consonantal coda is present. The factor groups used in the analysis are the same as those listed in Table 4.64 for sequential units. At the end of this section, the constraints on variation present in the sequential and non-sequential models will be compared across and between nasal units.

The regression model for F1 in [ẽ] is presented in Table 4.79. Syllable type and lexical frequency are returned as significant predictors of F1 by the analysis, while speaker sex and F2 are non-significant. The effect of syllable type is highly significant (p=1.92e-07) and the magnitude of the effect is large. The pattern for

syllable context is the same as for sequential [ɛN]: final (open and closed) syllables favour high F1 values (or lower vowels); medial (open) syllables favour low F1 values (or higher vowels). Lexical frequency exhibits a significant ($p \leq 0.05$) negative correlation with F1 for which the magnitude is large: high frequency lexical items contain vowels with lower F1 values than low frequency items. This means that the vowels in high frequency lexical items are acoustically higher than in low frequency words. The articulatory correlate of this may be a raised tongue configuration for vowels in high frequency words or this may be linked to velar aperture. For example, it is possible that high frequency words are more nasalised, in line with the supralocal norm, and thus have lower F1 values.

Nasal Unit = [ɛ]		Deviance: 183		
Dependent variable = F1		Degrees of freedom: 9		
N = 86				
Grand mean = -0.265				
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/Cɤ#/	0.524	43	1.92e-07
	/CɤC#/	0.274	5	
	/ɤCV(C)#/	-0.798	38	
Lexical frequency	Continuous (log-transformed)	-0.313		0.0374
Non-significant factor groups were Speaker sex ($p=0.724$) and F2 ($p=0.736$).				

Table 4.79. All speakers: Results of mixed-effects linear regression for F1 in [ɛ].

Table 4.80 presents the results of the regression model run for F2 in [ɛ] for all speakers where no significant predictors were returned.

Nasal Unit = [ɛ̃] Dependent variable = F2 N = 86 Grand mean = 1.082	Deviance: 219 Degrees of freedom: 9
Non-significant factor groups were Speaker sex (p=0.114), Lexical frequency (p=0.426), F1 (p=0.533), and Syllable type (p=0.543).	

Table 4.80. All speakers: Results of mixed-effects linear regression for F2 in [ɛ̃].

The regression models of F1 and F2 for [œ̃] vowels are presented in Tables 4.81 and 4.82 respectively. In both cases, no predictors are returned by the analyses as significant. Syllable type was excluded as a fixed effect because all non-sequential occurrences of /œ̃/ were in final open syllables.

Nasal Unit = [œ̃] Dependent variable = F1 N = 30 Grand mean = -0.367	Deviance: 47 Degrees of freedom: 7
Non-significant factor groups were Lexical frequency (p=0.0547), Speaker sex (p=0.247), and F2 (p=0.462)	

Table 4.81. All speakers: Results of mixed-effects linear regression for F1 in [œ̃].

Nasal Unit = [œ̃] Dependent variable = F2 N = 30 Grand mean = 0.213	Deviance: 47 Degrees of freedom: 7
Non-significant factor groups were F1 (p=0.398), Lexical frequency (p=0.555), and Speaker sex (p=0.751).	

Table 4.82. All speakers: Results of mixed-effects linear regression for F2 in [œ̃].

The regression model presented in Table 4.83 examines the distributions of F1 for the front nasal vowels in non-sequential nasal units. The results show that phoneme cannot significantly predict the value of F1. This confirms that, when all speakers are considered, there is no significant phonetic distinction being made between [ɛ̃] and [œ̃] on the F1 dimension. Speaker sex and the interaction term are also returned as non-significant. In sequential units (Table 4.69), speaker sex was a

significant predictor and male speakers distinguished between the phonemes /*ẽ*/ and /*œ*/ on the basis of F1 (Table 4.70).

Nasal Unit = [<i>ẽ œ</i>] Dependent variable = F1 N = 116 Grand mean = -0.291	Deviance: 276 Degrees of freedom: 7
Non-significant factor groups were Speaker sex (p=0.197), Phoneme (p=0.721) and Sex*Phoneme (p=0.901).	

Table 4.83. All speakers: Results of mixed-effects linear regression for F1 in [*ẽ œ*].

The regression model for F2 in the front nasal vowels is presented in Table 4.84. Phoneme is returned as a very highly significant predictor of F2: /*ẽ*/ favours high F2 values while /*œ*/ favours lower F2 values. The magnitude of this effect is relatively large, showing that, in non-sequential units, /*ẽ*/ and /*œ*/ are discriminated significantly on the basis of their F2 values.

Nasal Unit = [ẽ œ]		Deviance: 279		
Dependent variable = F2		Degrees of freedom: 7		
N = 116				
Grand mean = 0.857				
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ẽ/	0.42	86	0.00709
	/œ/	-0.42	30	
Non-significant factor groups were Speaker sex (p=0.238) and Sex*Phoneme (p=0.412).				

Table 4.84. All speakers: Results of mixed-effects linear regression for F2 in [*ẽ œ*].

Moving on to the back nasal vowels, the model for F1 values of non-sequential [*ã*] vowels is presented in Table 4.85. Syllable type and F2 are returned as significant predictors of F1 ($p \leq 0.05$) while speaker sex and lexical frequency are excluded from the model by the analysis. The effect of syllable type shows final open syllables to favour relatively higher F1 values and medial open syllables to

favour lower F1 values. The regression coefficient for closed final syllables is relatively neutral. These regression coefficients show that lower vowels occur in final syllables while more centralised vowels occur in medial syllables. F2 is negatively correlated to F1 but the magnitude of this correlation is relatively small.

Nasal Unit = [ã] Dependent variable = F1 N = 78 Grand mean = 0.721		Deviance: 202 Degrees of freedom: 0.721		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C $\tilde{v}$ #/	0.516	39	0.0177
	/C $\tilde{v}$ C#/	-0.068	24	
	/ $\tilde{v}$ CV(C)#/	-0.448	15	
F2	Continuous variable	0.062	78	0.029
Non-significant factor groups were Speaker sex (p=0.667) and Lexical frequency (p=0.714).				

Table 4.85. All speakers: Results of mixed-effects linear regression for F1 in [ã].

The F2 regression model for non-sequential [ã] is provided in Table 4.86. Only the F1/F2 correlation is returned as significant: F1 is positively correlated to F2. We may note that lexical frequency is excluded from the model as non-significant whereas it was a significant predictor of vowel frontness/backness in the sequential environment. It is possible that the ‘standard’ environment (i.e. without the nasal consonant coda) favours F2 lowering so that there exists no front-back alternation for low and high frequency lexical items respectively.

Nasal Unit = [ã] Dependent variable = F2 N = 78 Grand mean = -0.207		Deviance: 131 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.159	78	0.0204
Non-significant factor groups were Lexical frequency (p=0.421), Speaker sex (p=0.499), and Syllable type (p=0.532).				

Table 4.86. All speakers: Results of mixed-effects linear regression for F2 in [ã].

The regression model for F1 in [ɔ̃] is presented in Table 4.87 and only syllable type is returned by the analysis as a significant predictor of F1: final syllables favour high F1 values; medial (open) syllables favour low F1 values. This pattern of high vowels in medial syllables and low vowels in final syllables is common across the nasal vowels in both non-sequential and sequential nasal units.

Nasal Unit = [ɔ̃] Dependent variable = F1 N = 82 Grand mean = -0.271		Deviance: 199 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/Cɔ̃#/	0.313	45	0.00239
	/Cɔ̃C#/	0.223	14	
	/ɔ̃CV(C)#/	-0.536	23	
Non-significant factor groups were F2 (p=0.173), Lexical frequency (p=0.522), and Speaker sex (p=0.647).				

Table 4.87. All speakers: Results of mixed-effects linear regression for F1 in [ɔ̃].

Table 4.88 presents the model for F2 in which no significant predictors have been included.

Nasal Unit = [ɔ̃] Dependent variable = F2 N = 82 Grand mean = -0.754	Deviance: 166 Degrees of freedom: 9
Non-significant factor groups were Lexical frequency (p=0.0922), F1 (p=0.18), Speaker sex (p=0.199), and Syllable type (p=0.347).	

Table 4.88. All speakers: Results of mixed-effects linear regression for F2 in [ɔ̃].

The regression model for the back nasal vowels is presented in Table 4.89 for the non-sequential nasal units [ã ɔ̃]. This model assessed the phonetic distinction made between [ã] and [ɔ̃] on the basis of F1. Phoneme is returned as a very highly significant predictor of the variation observed in F1 (p=3.2e-08): /ã/ favours high F1 values while /ɔ̃/ favours low F1 values. This confirms that, in non-sequential, /ã/ and /ɔ̃/ are distinguished significantly on the basis of F1 when all speakers are considered together: [ã] is a lower vowel than [ɔ̃]. Speaker sex and the sex*phoneme interaction term are returned as non-significant by the analysis.

Nasal Unit = [ã ɔ̃] Dependent variable = F1 N = 160 Grand mean = 0.212		Deviance: 434 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.539	78	3.2e-08
	/ɔ̃/	-0.539	82	
Non-significant factor groups were Speaker sex (p=0.803) and Sex*Phoneme (p=0.819).				

Table 4.89. All speakers: Results of mixed-effects linear regression for F1 in [ã ɔ̃].

Finally, Table 4.90 presents the regression model for F2 for the combined [ã ɔ̃] data set. As above, phoneme is returned as very highly significant (p=1.47e-06) while speaker sex and the sex*phoneme interaction term are returned as non-significant. For phoneme, /ã/ is shown to favour higher F2 values (fronter vowels)

than /ɔ̃/. Therefore, /ã/ is significantly different from /ɔ̃/ on the basis of F1 and F2:

/ã/ is lower and fronter than /ɔ̃/.

Nasal Unit = [ã ɔ̃] Dependent variable = F2 N = 160 Grand mean = -0.487		Deviance: 313 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.325	82	1.47e-06
	/ɔ̃/	-0.325	78	
Non-significant factor groups were Speaker sex (p=0.603) and Sex*Phoneme (p=0.0672).				

Table 4.90. All speakers: Results of mixed-effects linear regression for F2 in [ã ɔ̃].

Table 4.91 summarises the results of the statistical analyses for sequential and non-sequential nasal units. The analyses of F1 revealed that, with the exception of /œ̃/, syllable type is the most consistent predictor across vowels in both types of nasal units. There is a significant relationship between F1 and F2 for all vowels (except /œ̃/) in sequential units but when a nasal consonant is absent from the nasal unit, this F1/F2 correlation is only returned as significant for /ã/. In sequential units, the most reliable predictor of F2 is F1. We noted that this relationship may be governed at a superordinate level by nasalisation which lowers both F1 and F2 simultaneously rather than by correlations in lingual configuration between fronting and lowering. In non-sequential units, no predictors of F2 were returned as significant across vowels, with the exception of /ã/ for which F1 is a significant predictor. It is possible that the absence of a correlation between F1 and F2 is related to degrees of nasalisation. There is evidence to suggest that the presence of a nasal consonant increases ‘denasalisation’ (Taylor, 1996; De Mareüil et al., 2007), that is, there is more variability in nasalisation in sequential units than in non-sequential

nasal units. It is possible that this increased variability in nasalisation in sequential units reveals a positive correlation between F1 and F2 as a function of varying degrees of nasal coupling.

Formant	VN-variants			V-variants		
	Vowel	Predictor	p-value	Vowel	Predictor	p-value
F1	[ɛ̃N]	Syllable type	0.000282	[ɛ̃]	Syllable type	1.92e-07
		F2	0.00988		Lexical frequency	0.0374
	[œ̃N]	Speaker sex	0.038	[œ̃]	No predictors	-
	[ãN]	Syllable type	0.000526	[ã]	Syllable type	0.0177
					F2	0.029
	[õN]	F2	0.000138	[õ]	Syllable type	0.00239
		Syllable type	0.00172			
F2	[ɛ̃N]	F1	0.0064	[ɛ̃]	No predictors	-
	[œ̃N]	No predictors	-	[œ̃]	No predictors	-
	[ãN]	F1	0.00537	[ã]	F1	0.0204
		Syllable type	0.0227			
		Lexical frequency	0.0355			
	[õN]	F1	0.000211	[õ]	No predictors	-

Table 4.91. Summary of regression models for F1 and F2 in sequential and non-sequential nasal units.

4.4.2 LIP-ROUNDING AND F3

This section examines the correlation between lip-rounding and the value of F3 as well as the use of this correlation in distinguishing phonetically between the vocalic elements of /ɛ̃/-/œ̃/ and /ã/-/õ/. In the case of /ɛ̃/-/œ̃/, lip-rounding distinguishes the latter from the former in SF. There is also some evidence to suggest that lip-rounding of /õ/ distinguishes it from /ã/ (cf. Hansen, 1998; 2001). Since the F1-F2

data presented above revealed varying levels of overlap between /ã/ and /õ/ in sequential and non-sequential nasal units, this section also investigate the role of F3 in maintaining this phonological distinction.

Figure 4.33 presents the sequential speaker means and standard deviations for individual male speakers. All speakers exhibit an overlapping distribution between the F3 values of [ẽN] and [œN]. With the exception of Speaker J, the separation between the mean values of the vowels is in the expected direction with lower F3 values for [œN], implying more lip-rounding.

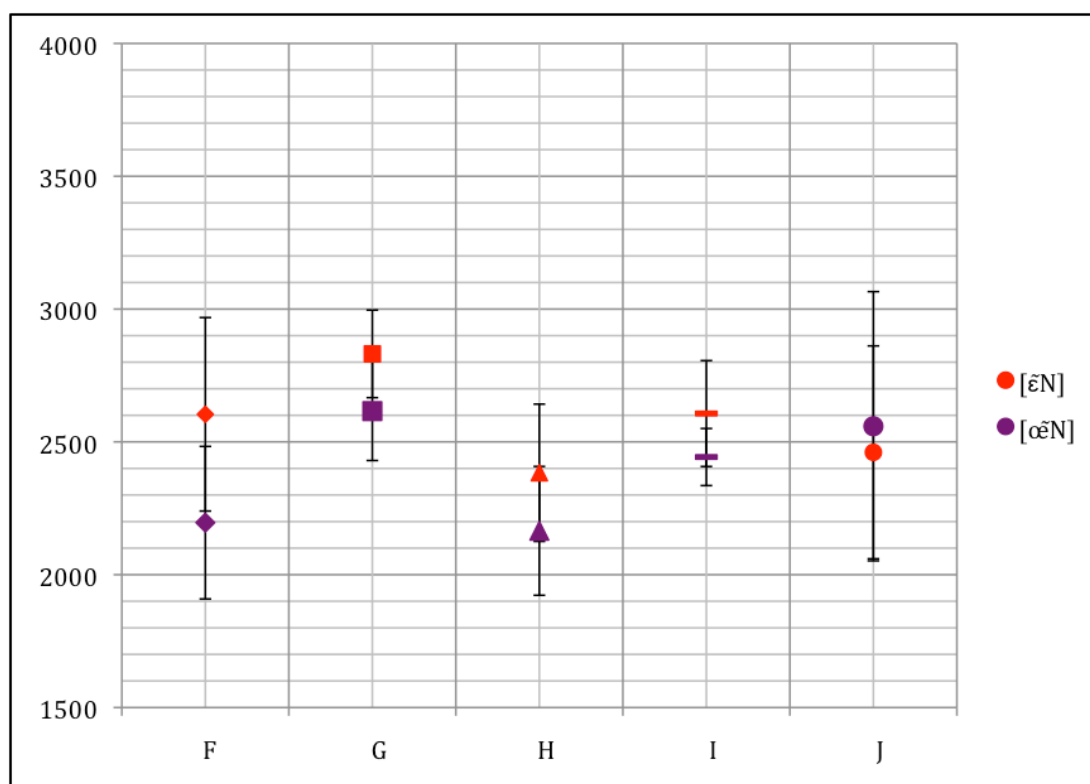


Figure 4.33. Male speakers: Mean F3 values and standard deviations for sequential nasal units.

Figure 4.34 presents the same information for /ẽ/ and /œ/ in non-sequential nasal units for individual male speakers. Speakers G, I and J show similar overlapping distributions for F3 in [ẽ] and [œ]. Speaker H exhibits separation

between the mean F3 values for each of the vowels but the [œ̃] data point is based on only one token. Speaker F has no data point for [œ̃] making comparison impossible.

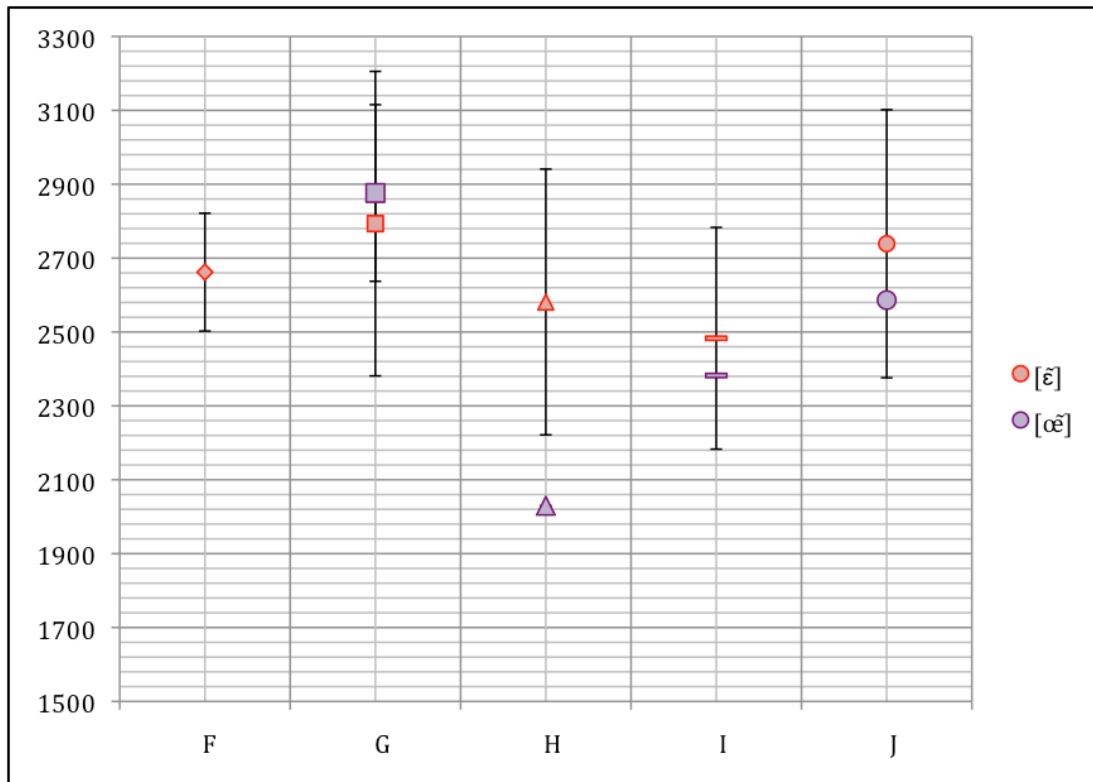


Figure 4.34. Male speakers: Mean F3 values and standard deviations for non-sequential nasal units.

Figure 4.35 presents the sequential speaker means and standard deviations for individual female speakers. There is a high level of overlap evident between [ɛ̃N] and [œ̃N] when individual speakers are considered separately. While some speakers show a tendency for the mean value of [ɛ̃N] to be higher than that of [œ̃N], Speaker B, for example, shows completely overlapping standard deviations for the front vowels.

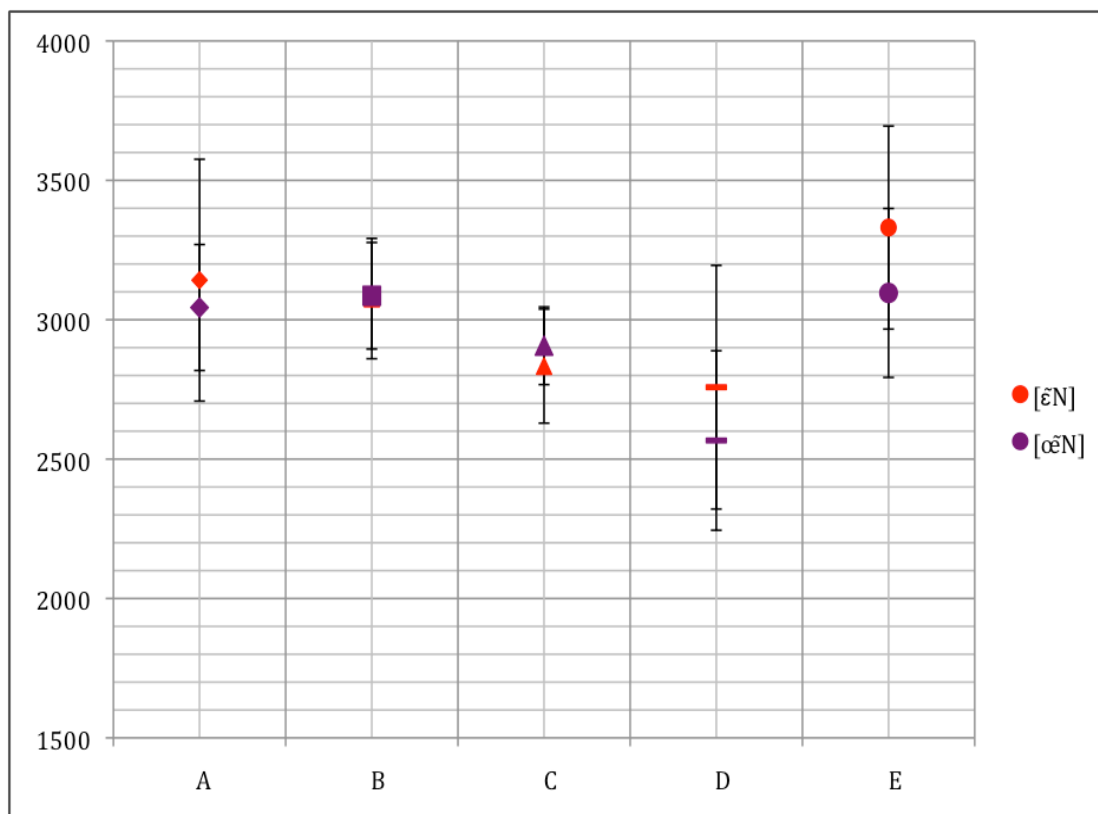


Figure 4.35. Female speakers: Mean F3 values and standard deviations for sequential nasal units.

For the non-sequential nasal units, Figure 4.36 presents the F3 data for female speakers. Overlap is evident between the distributions of F3 for [ɛ̃] and [œ̃] for all speakers (with the exception of Speaker E who does not have a data point for [ɛ̃]). This shows that F3 does not exhibit the expected lower values for /œ̃/ across nasal units and across speakers, suggesting that older speakers do not make a lip-rounding distinction between /ɛ̃/ and /œ̃/ in their French.

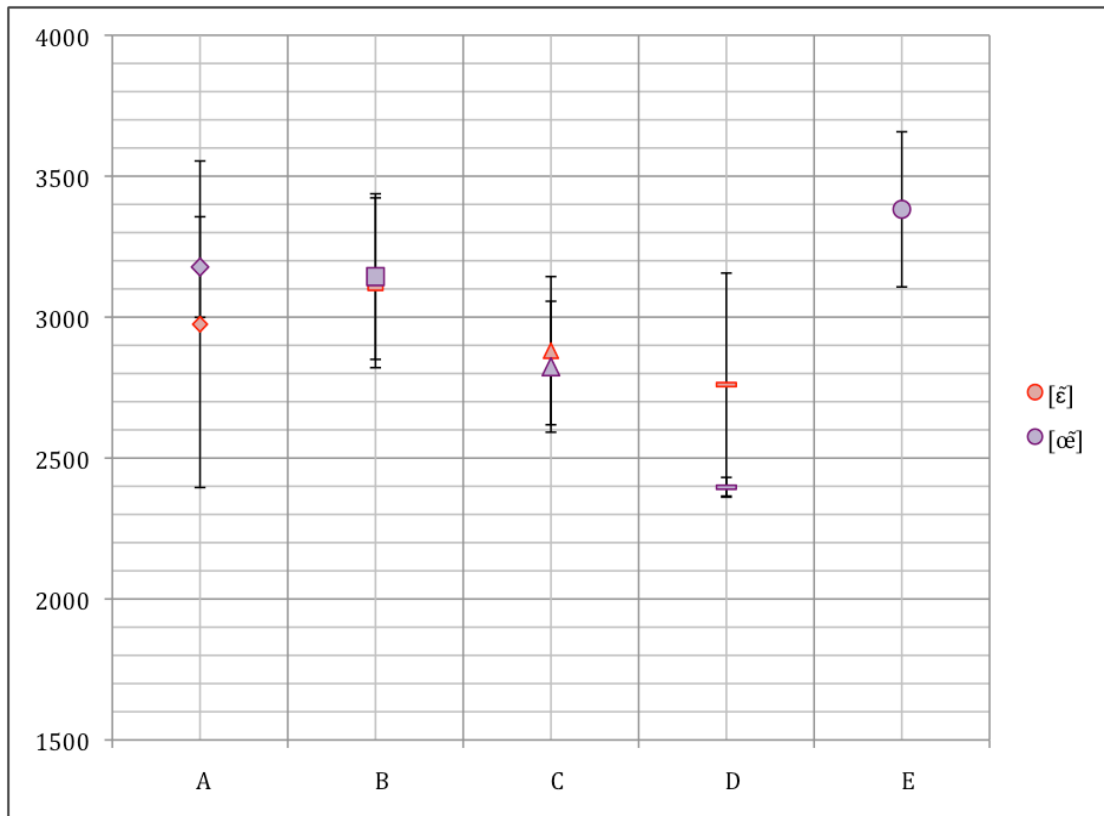


Figure 4.36. Female speakers: Mean F3 values and standard deviations for non-sequential nasal units.

Figure 4.37 presents the sequential speaker means and standard deviations for individual male speakers for /ãN/ and /ɔ̃N/ in sequential nasal units. The F3 means and distributions are completely overlapping in sequential units for all male speakers. This shows that F3 is not used by male speakers to distinguish between [ãN] and [ɔ̃N].

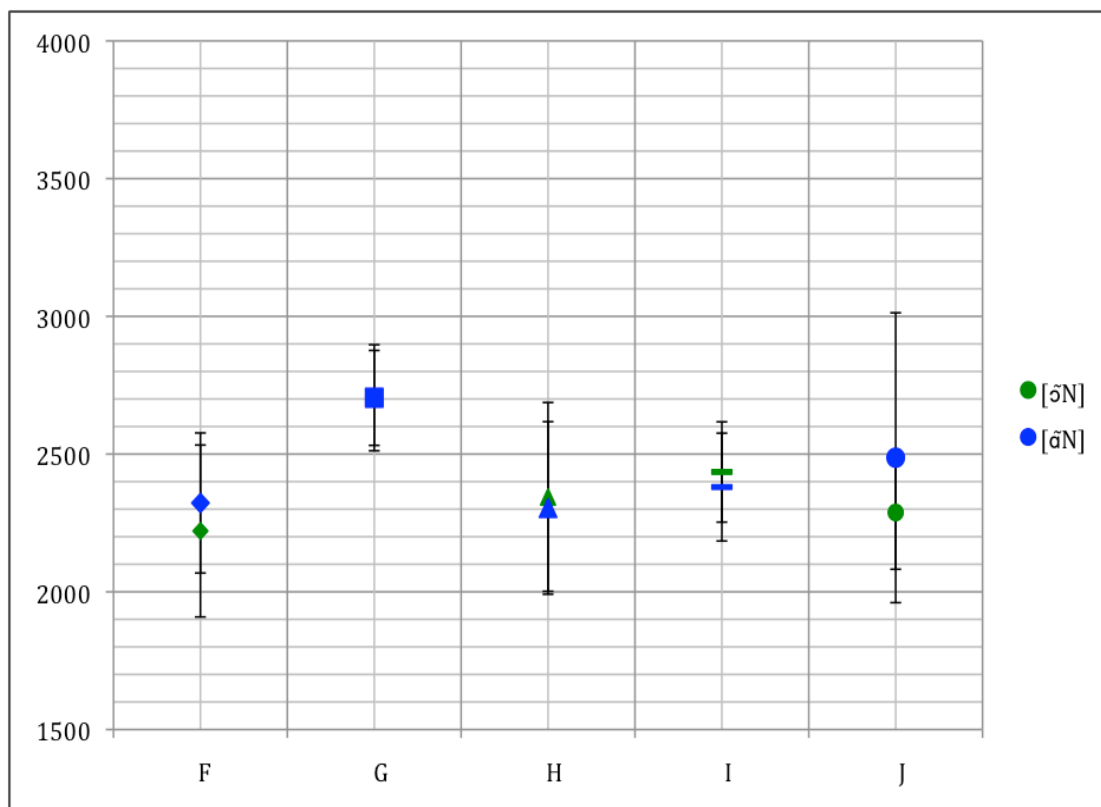


Figure 4.37. Male speakers: Mean F3 values and standard deviations for sequential nasal units.

The F3 data for non-sequential units is presented for male speakers in Figure 4.38. Speaker H and Speaker J do not have data points for [ɔ̃] making comparison with [ɑ̃] impossible. For all other speakers, the distributions of F3 for [ɑ̃] and [ɔ̃] are overlapping.

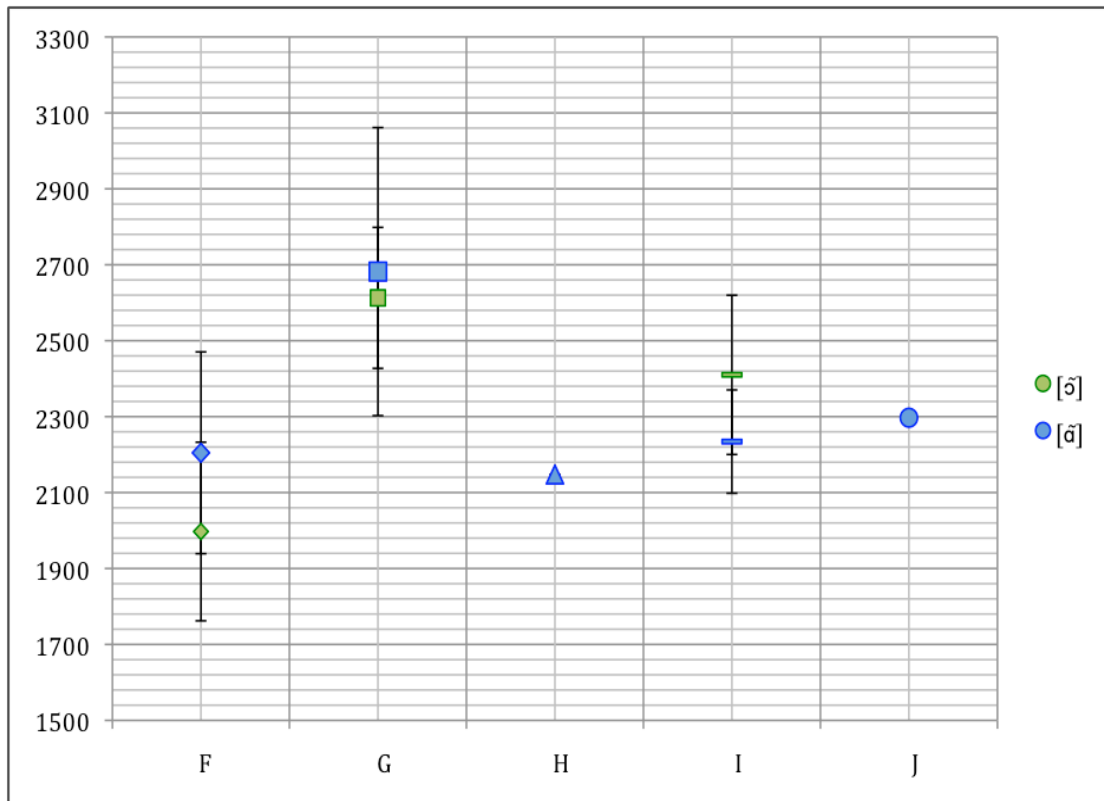


Figure 4.38. Male speakers: Mean F3 values and standard deviations for non-sequential nasal units.

Figure 4.39 presents the sequential unit speaker means and standard deviations for individual female speakers. The F3 means and distributions are completely overlapping in sequential units for all speakers.

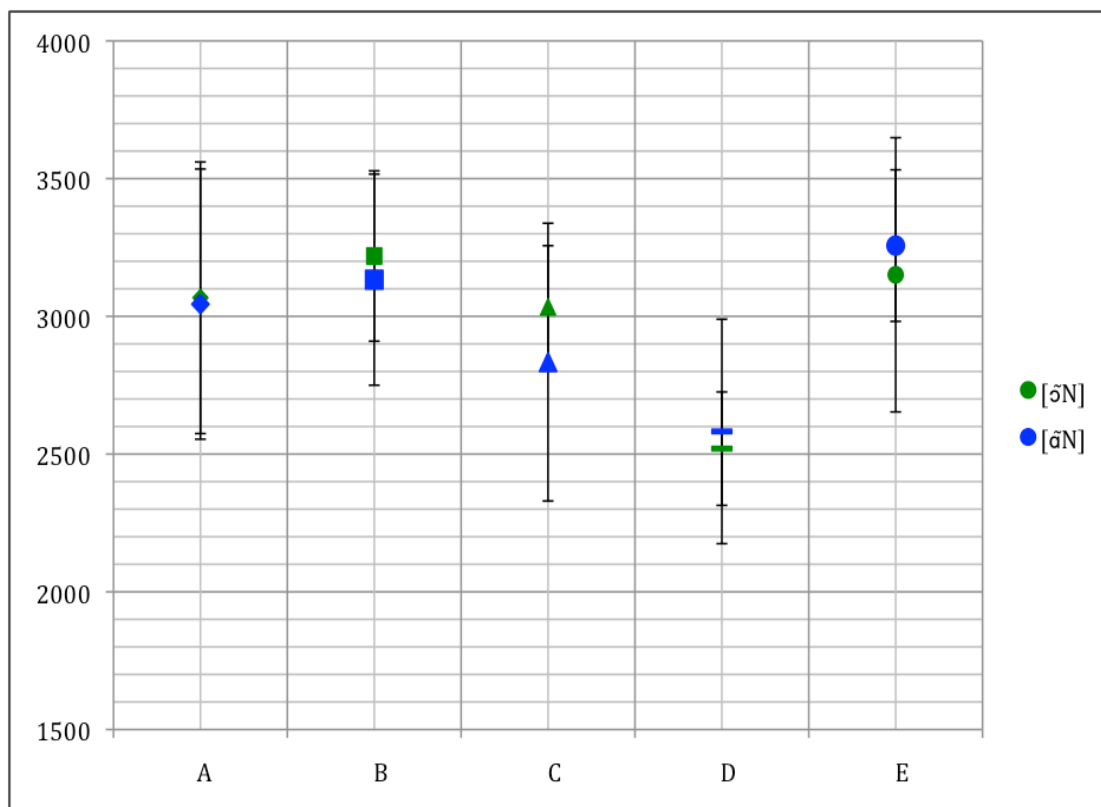


Figure 4.39. Female speakers: Mean F3 values and standard deviations for sequential nasal units.

The F3 data for non-sequential units is presented for female speakers in Figure 4.40. Again, all speakers exhibit completely overlapping distributions for the back nasal vowels in terms of F3. This suggests that for / $\tilde{a}$ / and / $\tilde{o}$ / in both sequential and non-sequential nasal units, F3 is not used consistently to distinguish the vowels. Consequently, this suggests that the basic difference between / $\tilde{a}$ / and / $\tilde{o}$ / is not lip-rounding of the latter.

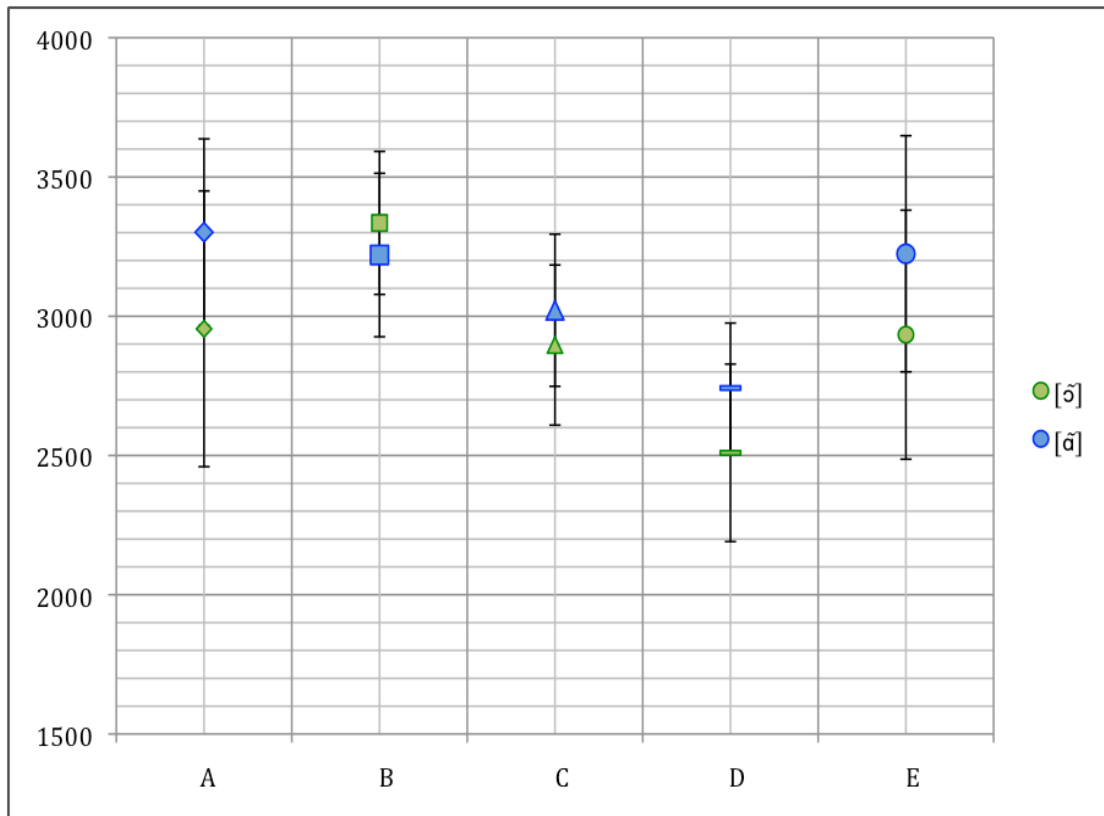


Figure 4.40. Female speakers: Mean F3 values and standard deviations for non-sequential nasal units.

4.4.2.1 MODELLING LIP-ROUNDING AND F3

This section presents the statistical models of F3, focusing primarily on the relationship between F3 and the feature [+round], commonly assumed to distinguish front /œ̃/ from /ɛ̃/, and back /ɔ̃/ and /ɑ̃/. Each pair will be examined separately in sequential and non-sequential units.

Table 4.92 presents the mixed-effects regression model for F3 in the front nasal vowels in sequential units. Two fixed effect predictors (speaker sex, phoneme) were included in the analysis. Phoneme is returned as a significant predictor of F3 ($p \leq 0.05$): /ɛ̃/ favours significantly higher F3 values than /œ̃/. As F3 lowering is a common acoustic correlate of lip-rounding, this result suggests that the contrastive rounding distinction is retained between the front nasal vowels, when all speakers are

considered. The interaction between speaker sex and phoneme is also returned as significant ($p \leq 0.05$): female speakers exhibit higher F3 values for /œ/ than male speakers and lower F3 values for /ɛ/ than male speakers. There is less F3 separation between /ɛ/ and /œ/ for female speakers than for male speakers: this suggests a gradual reduction in the phonetic distinction between the vowels, suggesting some convergence towards the supralocal norm (merged /ɛ/ and /œ/).

Nasal Unit = [ẽN œN] Dependent variable = F3 N = 389 Grand mean = 0.126		Deviance: 1039 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Sex*Phoneme	Female:/œ/	0.11	55	0.0296
	Male:/ẽ/	0.11	127	
	Female:/ẽ/	-0.11	138	
	Male:/œ/	-0.11	69	
Phoneme	/ẽ/	0.252	265	0.039
	/œ/	-0.252	124	
Non-significant factor groups were Speaker sex (p=0.0768).				

Table 4.92. All speakers: Results of mixed-effects linear regression for F3 in [ɛN œN].

The regression model for the front nasal vowels in non-sequential units is presented in Table 4.93. Phoneme and the interaction term are returned by the model as non-significant. This means that /ɛ/ and /œ/ are not distinguished significantly on the basis of F3 when they occur in nasal units with no nasal consonant coda. This contrasts with the situation presented above for sequential nasal units, where the phonemes are distinguished on the basis of F3 when they occur in nasal units where a nasal consonant coda is present. Sequential units are non-standard in that nasal consonant codas do not occur in supralocal French and it is precisely in this context

that the non-standard /ẽ/~/œ/ distinction is maintained. In the non-sequential context, when no nasal consonant coda is present, speakers appear to use a supralocal three-term nasal vowel system. Speaker sex is returned as the only significant predictor of the variation observed in F3 with male speakers favouring higher F3 values overall than female speakers. This does not make sense linguistically since the F3 values are based on /ẽ/ and /œ/ data combined. Separate models considering male and female speakers separately both return ‘phoneme’ as a non-significant predictor (p=0.535 and p=0.488, respectively) of the variation observed. This confirms that all speakers are using only one front nasal vowel in non-sequential nasal units.

Nasal Unit = [ẽ œ]		Deviance: 335		
Dependent variable = F3		Degrees of freedom: 7		
N = 116				
Grand mean = 0.169				
Factor Group	Factor	Coeff.	N	P-value
Sex	Male	0.251	49	0.00733
	Female	-0.251	67	
Non-significant factor groups were Phoneme (p=0.506) and Sex*Phoneme (p=0.635).				

Table 4.93. All speakers: Results of mixed-effects linear regression for F3 in [ẽ œ].

Moving on to the back vowels, Table 4.94 presents the results of the regression model for F3 in /ã/ and /õ/ in sequential units. Phoneme is a non-significant predictor of F3 variation. This shows that /ã/ and /õ/ are not distinguished significantly on the basis of F3. We saw previously, however, that the back nasal vowels were distinguished significantly on the basis of F1 and F2.

Nasal Unit = [ãN ãN] Dependent variable = F3 N = 659 Grand mean = -0.087	Deviance: 1842 Degrees of freedom: 6
Non-significant factor groups were Phoneme (p=0.966), Speaker Sex (p=0.304) and Sex*Phoneme (Error).	

Table 4.94. All speakers: Results of mixed-effects linear regression for F3 in [ãN ãN].

Table 4.95 presents the same regression analysis in non-sequential nasal units. Again, phoneme (and the interaction term) is a non-significant predictor of F3: /ã/ and /ã/ are not distinguished significantly on the basis of F3 when no nasal consonant coda is present. The difference in the F3 distribution for male and female speakers is returned as significant by the model. This result is also opaque due to the combined data set. Separate regression models for male and female speakers return p-values of 0.964 and 0.0973 respectively for ‘phoneme’ as a fixed effect. Again, /ã/ and /ã/ were shown to be distinguished significantly on the basis of F1 and F2 in non-sequential nasal units. The results for the back nasal vowels are thus the same.

Nasal Unit = [ã ẽ]		Deviance: 456		
Dependent variable = F3		Degrees of freedom: 7		
N = 160				
Grand mean = -0.068				
Factor Group	Factor	Coeff.	N	P-value
Sex	Female	0.264	116	0.00669
	Male	-0.264	44	
Non-significant factor groups were Phoneme (p=0.228) and Sex*Phoneme (p=0.548).				

Table 4.95. All speakers: Results of mixed-effects linear regression for F3 in [ã ã].

4.4.3 NASAL CONSONANT CODAS

The presence of a nasal consonant coda with the French nasal vowels is variable and not lexically specified. This section will examine the distribution of nasal consonant presence or absence for each of the nasal vowels as well as the influence of syllable type on nasal consonant appearance. Additionally, this section will explore homorganic place of articulation assimilation of nasal consonants (if present) to the following phoneme. The tables below present data for male and female speakers together though the statistical analyses which follow will consider differential linguistic behaviour between the sexes.

The frequency distribution for nasal consonant presence and absence is presented in Table 4.96 for each of the four nasal units. The frequency of nasal consonant presence is comparably similar for all nasal vowels ranging from 75% for /œ̃/ to 81% for /ɛ̃/ and /ɑ̃/. This suggests that the identity of the historically appropriate phonemes does not have any substantial effect on the distribution of nasal consonants.

Nasal Unit	Consonant presence/absence		
	N	% Sequential	% Non-sequential
/ɛ̃/	420	81	19
/œ̃/	351	75	25
/ɑ̃/	154	81	19
/ɔ̃/	399	79	21

Table 4.96. All speakers: The relationship between nasal consonant presence/absence and nasal unit.

Table 4.97 considers the relationship between syllable type and nasal consonant presence for each nasal vowel separately and across all nasal vowels. /œ̃/ does not occur in closed final syllables (/C $\tilde{v}$ C#/) in the data set and is extremely infrequent in open medial syllables (/ $\tilde{v}$ CV(C)#/). The three non-final tokens of /œ̃/ included in the table all occur, with a nasal consonant coda, in the word ‘lundi’ /lœ̃di/. For these reasons, it is not possible to discuss the effect of syllable type on consonant absence/presence for /œ̃/ and we can simply say that in open final syllables (/C $\tilde{v}$ #/), where it occurs with the highest frequency, 80% of tokens are realised with a nasal consonant coda. For all of the other vowels, consonant presence is by far the majority variant but final open syllables can be seen to disfavour consonant presence. By comparison, final closed syllables appear to favour the presence of a nasal consonant relative to final open syllables. For medial open syllables, the distribution of sequential and non-sequential nasal units varies depending on the nasal vowel, disfavouring consonant presence for /ẽ/ and favouring consonant presence for /ã/ and /õ/. The overall pattern, considering all four nasal vowels together, suggests that final closed and medial open syllables favour consonant presence while final open syllables favour consonant absence.

Nasal Unit	N	Consonant presence/absence		
		Syllable Type	% Sequential	% Non-Sequential
/ɛ̃/	70	/CɥC#/	93	17
	140	/ɥCV(C)#/	73	27
	141	/Cɥ#/	70	30
/œ̃/	0	/CɥC#/	ND	ND
	3	/ɥCV(C)#/	100	0
	151	/Cɥ#/	80	20
/ɑ̃/	133	/CɥC#/	82	18
	147	/ɥCV(C)#/	90	10
	140	/Cɥ#/	72	28
/ɔ̃/	101	/CɥC#/	86	14
	147	/ɥCV(C)#/	84	16
	151	/Cɥ#/	70	30
Total	304	/CɥC#/	86	14
	437	/ɥCV(C)#/	83	17
	583	/Cɥ#/	73	27

Table 4.97. The relationship between nasal consonant presence/absence and syllable type sequential nasal units.

Finally, Table 4.98 presents a selection of data from the French sequential unit data set to explore the assimilation of nasal consonants in place of articulation to the following phonemic environment. The majority variant in pre-pausal environments is, as expected in southern varieties of French, the velar nasal [ŋ]. There are also twenty occurrences of [n] in pre-pausal environments and one occurrence of [m]. The latter occurs in the word ‘personnellement’ /pɛʁsɔnɛlmɑ̃/

[pərsɔneləmãm]] which may be a case of progressive assimilation at a distance to the place of articulation of the preceding nasal consonant /m/. For the voiced and voiceless plosive pairs /p b/, /t d/, and /k g/, the majority pattern for preceding nasal consonants exhibits homorganic place of assimilation in each case:

Following Phoneme	Consonant Quality			
	[n]	[m]	[ɲ]	[ŋ]
# (pause)	20	1	0	73
/p/	4	103	0	2
/b/	0	33	0	0
/f/	0	0	15	0
/v/	6	0	2	1
/t/	222	2	0	6
/d/	167	0	0	5
/k/	7	0	0	118
/g/	0	0	0	19
/s/	108	0	0	1
/z/	18	0	0	0
/ʃ/	2	0	0	0
/ʒ/	34	0	0	1

Table 4.98. The relationship between nasal consonant coda place of articulation and following phoneme, sequential nasal units.

[m] before labial consonants; [n] before dental consonants; [ɲ] before velar consonants. There are four occurrences of [n] and two occurrences of [ɲ] before /p/ in the words ‘bon’ /bɔ̃/, ‘sont’ /sɔ̃/, ‘souviens’ /suvjɛ̃/, and ‘un’ /œ̃/ (with [n]) and in the words ‘comprends’ /kɔ̃pʁɑ̃/ and ‘temps’ /tɑ̃/ (with [ɲ]). Two realisations of [m] occur before /t/ (in the words ‘compte’ /kɔ̃t/ and ‘comptez’ /kɔ̃te/) as well as

six realisations of [ŋ] (in the words ‘cinquante’ /sɛ̃kɑ̃t/ (x3), ‘coin’ /kwɛ̃/ and ‘temps’ /tɑ̃/). The realisations of [m] are almost certainly due to the influence of orthography on pronunciation. Five nasal consonants are realised as [ŋ] before /d/ in the words ‘quelqu’un’ /kɛlkœ̃/, ‘commerçants’ /kɔ̃mɛʁsɑ̃/, ‘appartement’ /apɑ̃ʁtəmɑ̃/, ‘font’ /fɔ̃/ and ‘façon’ /fasɔ̃/ and there are seven tokens of [n] before /k/ in the words ‘cinq’ /sɛ̃k/ (x2), ‘cinquante’ /sɛ̃kɑ̃t/, ‘donc’ /dɔ̃k/ (x2), ‘moins’ /mwɛ̃/ and ‘paysans’ /peizɑ̃/. For nasal consonants preceding the voiced and voiceless fricative pairs /f v/, /s z/ and /ʃ ʒ/, the majority pattern is (with the exception of nasals preceding /v/) one of homorganic place of assimilation: [m] before labiodental consonants and [n] before dental and post-alveolar fricatives. There is one token of [ŋ] (in the word ‘canton’ /kɑ̃tɔ̃/) and six tokens of [n] before /v/ with the latter occurring in the words ‘bon’ /bɔ̃/ (x2), ‘conversation’ /kɔ̃vɛʁsasjɔ̃/, ‘convoqué’ /kɔ̃vɔ̃ke/ and ‘grand’ /gʁɑ̃/ (x2). One token of [ŋ] before each of /s/ and /ʒ/ in the words ‘font’ /fɔ̃/ and ‘donc’ /dɔ̃k/, respectively. In the case of ‘donc’, the final /k/ was deleted and the following word had /ʒ/ in initial position.

4.4.3.1 MODELLING NASAL CONSONANT CODAS

This section uses a mixed-effects logistic regression analysis to model the binary variable of consonant presence/absence across nasal units. The response variable is ‘presence’, ‘speaker’ and ‘word’ are included as random effects and the following

fixed effect factor groups were included in the analysis: phoneme, syllable type, speaker sex, lexical frequency. The descriptive analysis (Section 4.4.3) suggested that the phonemic identity of the nasal unit did not appear to affect the frequency of sequential nasal units. Syllable type, on the other hand, appeared to condition the variation observed: final closed (/C $\tilde{v}$ C#/) and open medial (/ $\tilde{v}$ CV(C)#/) syllables favour consonant presence; open final (/C $\tilde{v}$ #/) syllables favour consonant absence.

Table 4.99 presents the regression analysis for male and female speakers considered together. Lexical frequency and phoneme are returned as non-significant predictors, the latter confirming the hypothesis that phoneme was not important in predicting consonant presence. Syllable type, however, is returned as a very highly significant predictor ($p \leq 0.01$) of the variation observed: final closed and medial open syllables are shown to favour the presence of a nasal consonant coda while final open syllables favour non-sequential units, with no consonantal coda. The magnitude of this effect is large and follows the expected pattern, based on the frequency data. Speaker sex is also returned a significant predictor of consonant presence ($p \leq 0.05$) with male speakers using significantly more nasal consonant codas than female speakers.

Nasal Unit = /ẽ œ ã õ/ Dependent variable = Consonant absence/presence Response variable = Consonant presence N = 1324 Grand mean = 0.792		Deviance: 1189 Degrees of freedom: 10		
Factor Group	Factor	Log Odds	N	P-value
Syllable type	/C̃C#/	0.582	304	8.8e-08
	/̃CV(C)#/	0.391	437	
	/C̃#/	-0.973	583	
Speaker sex	Male	0.558	658	0.017
	Female	-0.558	666	
Non-significant factor groups were Lexical frequency (p=0.146) and Phoneme (p=0.401).				

Table 4.99. All speakers: Results of mixed-effects logistic regression for consonant absence/presence.

Looking at male speakers separately, the regression model in Table 4.100 shows that phonemic identity is more important than syllable type in predicting nasal consonant presence. The occurrence of a sequential unit is favoured by the back nasal vowels /õ/ and /ã/ with the open-mid vowel phoneme showing the largest regression coefficient: nasal consonants occur significantly more in /õ/ than in other nasal units. The front nasal vowels, /ẽ/ and /œ/, disfavour the occurrence of a nasal consonant in the nasal unit with /ẽ/ exhibiting the highest magnitude negative coefficient. The overall magnitude of this effect is large and the effect is very strong (p=0.000996). Syllable type is also returned as a significant effect, exhibiting the same pattern as the composite model above but at a lower significance level (p≤0.05).

Nasal Unit = /ẽ œ ã ỹ/ Dependent variable = Consonant absence/presence Response variable = Consonant presence N = 658 Grand mean = 0.859		Deviance: 463 Degrees of freedom: 9		
Factor Group	Factor	Log Odds	N	P-value
Phoneme	/ĩ/	0.807	200	0.000996
	/ã/	0.217	213	
	/œ/	-0.277	76	
	/ẽ/	-0.748	169	
Syllable type	/CĩC#/	0.808	151	0.0137
	/ĩCV(C)#/	-0.209	214	
	/Cĩ#/	-0.598	293	
Non-significant factor groups were Lexical frequency (p=0.0656).				

Table 4.100. Male speakers: Results of mixed-effects logistic regression for consonant absence/presence.

The model for female speakers in Table 4.101 returns syllable type as the only significant predictor of consonant presence and the strength of the effect is very highly significant ($p=1.05e-07$). The general pattern of the effect is the same with final closed and medial syllables favouring consonant presence and final open syllables favouring non-sequential units. The regression coefficients reveal, however, that the medial context is the most favourable environment for a nasal consonant to occur. Phoneme is the least significant predictor of nasal consonant presence. This shows that not only do male and female speakers realise nasal consonant codas at different rates but there are different constraints on the variation observed between the sexes.

Nasal Unit = /ẽ œ ã õ/ Dependent variable = Consonant absence/presence Response variable = Consonant presence N = 666 Grand mean = 0.725		Deviance: 701 Degrees of freedom: 0.725		
Factor Group	Factor	Log Odds	N	P-value
Syllable type	/ṽCV(C)#/	0.738	223	1.05e-07
	/CṽC#/	0.409	153	
	/Cṽ#/	-1.147	290	
Non-significant factor groups were Lexical frequency (p=0.492) and Phoneme (p=0.666).				

Table 4.101. Female speakers: Results of mixed-effects logistic regression for consonant absence/presence.

4.5 EVIDENCE FOR PHONOLOGICAL AND PHONETIC TRANSFER

The section will focus on unilateral linguistic transfer from the mid-vowel and nasal unit systems of Béarnais into the structurally related systems of French, examining both phonological and phonetic interference. We have previously noted that a large majority of research has focused on the effect of the L1 on L2 performance but that there has been growing evidence to suggest that the influence may be bi-directional (see Flege, 2007). The analysis of transfer presented here will not explicitly address this L2-to-L1 transfer. We must, however, bear in mind that the baseline Béarnais norm presented here for older speakers may diverge somewhat from the language used in their infancy and from any hypothetical monolingual Béarnais norm posited.

In examining phonological and phonetic transfer, evidence from the Béarnais and French data sets will be used to test the hypotheses advanced by Flege's Speech Learning Model (SLM) (see Chapter 1). This analysis aims explicitly to assess the linguistic mechanisms active during the emergence of RF from language contact and

to examine the status of RF as ‘substrate residue’. The concept of ‘equivalence classification’, as defined by the SLM, will be important in the investigation of transfer presented here: phonemes in the L1 and L2 that correspond structurally will be equated in the common phonological space and are thus termed ‘cognate phonemes’. Category formation is directly linked to equivalence classification within the SLM: if an L2 sound is equated with an L1 sound, new category formation will be inhibited; if an L2 sound is not equated with an L1 sound, a new phonetic category may be formed. Equivalence classification and category formation (which are mutually exclusive in the SLM) predict the interaction of L1 and L2 phonetic subsystems to be governed by the two different linguistic mechanisms of ‘phonetic category assimilation’ and ‘phonetic category dissimilation’, respectively.

4.5.1. TRANSFER IN THE MID-VOWELS

This section discusses evidence for phonological and phonetic transfer from Béarnais into French in the mid-vowels. Firstly, evidence for equivalence classification will be investigated by examining the parallels between phonemic categories in Béarnais and French. Secondly, evidence for phonetic category formation (predicted by the absence of equivalence classification) will be assessed and the linguistic mechanisms of phonetic category assimilation and phonetic category dissimilation will be discussed in detail. Finally, the cross-linguistic phonetic realisation rules (relating specifically to contextual allophones in different syllable types) will be investigated. At each level of analysis, the specific hypothesis derived from the SLM will be advanced, acoustic data and statistical analyses will be used to test these hypotheses, and any conclusions will be verified by an examination of phonetic data from individual speakers, where necessary.

4.5.1.1 PHONOLOGICAL TRANSFER IN THE MID-VOWELS

Evidence for phonological transfer must be based on evidence for equivalence classification, that structurally related phonemes in Béarnais and French are linked as ‘cognates’ and exist in a common phonological space. This section investigates the existence of phonemic cognates in Béarnais and French by comparing the statistical models of F1 and F2 for the mid-vowels of each language in Sections 4.1 and 4.3, respectively. The discussion will focus separately on the front and back mid-vowels.

Based on the traditional accounts of Béarnais and French, the specific hypothesis derived from the SLM is that the existence of the phonemes /e/ and /ɛ/ in Béarnais will be equated with French /e/ and /ɛ/ in common phonological space, facilitating their retention in emergent RF. In Béarnais, speakers make a statistically significant phonetic distinction between /e/ and /ɛ/ on the basis of F1 (± 0.115 ; $p < 0.01$) but do not distinguish the phonemes on the basis of F2 (see Tables 4.3 and 4.4). In French, speakers also distinguish between /e/ and /ɛ/ on the basis of F1 (± 0.342 ; $p < 0.01$) and make no significant front/back (F2) distinction between the phonemes (see Tables 4.59 and 4.60). Therefore, the bilingual speakers make a comparably significant phonetic distinction between the front mid-vowels on the basis of vowel height in both languages: /e/ is higher than /ɛ/. The existence of phonemic categories for /e/ and /ɛ/ in both of the bilinguals’ languages lends weight to the hypothesis that they would be equated in a common abstract phonological representation and that they would thus be stored in common phonetic categories, [e] and [ɛ]. The phonetic nature of each of these categories (and of each of the languages in each category) will be investigated in Section 4.5.1.2 below. It

has been noted that the existence of /e/ and /ɛ/ in Béarnais (or, more generally, in *langue d'oc*) may facilitate the maintenance of this contrast in the French of bilingual speakers (Morin, 2005; Moreux, 2006; Durand, 2009). The results presented here from, the perspective of the SLM, certainly suggest that this is true, whereas this distinction is not realised by many monolingual French speakers.

For the back mid-vowels, the SLM-derived hypothesis predicts that the existence of one back mid-vowel phonemic category in Béarnais /ɔ/ will lead to the establishment of a single phonemic category in French (for /o/ and /ɔ/). Put another way, equivalence classification will equate the two French sounds with the single sound in Béarnais as the phonetic height distinction between French /o/ and /ɔ/ is not meaningful in Béarnais. The statistical analyses of F1 and F2 in French confirmed this hypothesis: no significant effect is returned for phoneme in either analysis (see Tables 4.61 and 4.62). In French, the bilingual speakers do not make a significant phonetic distinction between /o/ and /ɔ/, demonstrating that these sounds occupy a single phonemic category, which is, in SLM terms, equated with Béarnais /ɔ/ in a common abstract phonological representation. I shall use the symbol /O/ to designate the common phonemic category for French /o/ and /ɔ/, following the usage of Durand: ‘les symboles E, Ø, O ne représentent pas des archiphonèmes au sens de Martinet mais des voyelles sous-spécifiées pour l’aperture [...] ou des classes de sons pour rester théoriquement plus neutre’ (2009:6). We can thus conclude that, based on this analysis, Béarnais /ɔ/ and French /O/ are cognate phonemes for the bilingual speakers.

Durand notes the existence of many southern varieties of French which maintain a phonetic distinction between the front mid-vowels /e/ and /ɛ/ while neutralising the distinction between /o/ and /ɔ/ (and also between /ø/ and /œ/) (2009:6). Martinet views such neutralisation as a consequence of articulatory asymmetry between the possible degrees of vowel height in the front and back of the vowel space:

‘pour le même nombre de phonèmes dans la série d’avant et d’arrière, les marges de sécurité seront plus étroites à l’arrière qu’à l’avant, et ceci peut, en partie, expliquer les divergences de comportement entre les deux séries.’

(Martinet, 1955:99)

While there may exist some articulatory bias favouring the existence of a single back vowel category in French, this asymmetry is not present in many other varieties of metropolitan French and, in the case of the supralocal norm, there is partial assimilation of phonological contrast in the front and back of the mid-vowel space with a range of partly structured phonetic realisations. It is most likely therefore that this is language contact effect. Flege notes that this type of transfer at the phonemic category level occurs when L2 learners fail to note perceptually phonetic differences that distinguish contrastive sound units of the L2, or which distinguish L2 sounds from sounds in the L1:

‘As the result of pre-attentive processes established in early childhood, learners of an L2 might simply ignore phonetic differences not directly relevant to contrasts between sounds of the L1.’

(Flege, 1995a:99)

Flege et al. (1999) illustrate this by showing that Italian speakers of English failed to discriminate significantly between pairs of English tense and lax vowels (e.g. /i/ ~ /ɪ/) for which a single tense phonemic category existed in their L1 (e.g. /i/).

This section has established the existence of three potential equivalence classes: Béarnais /e/ and French /e/; Béarnais /ɛ/ and French /ɛ/; Béarnais /ɔ/ and French /O/. In each case, equivalence classification should hypothetically block category formation for French sounds in which case, the Béarnais and French sounds would, via the process of cross-language phonetic category assimilation, resemble each other in production.

4.5.1.2 PHONETIC TRANSFER IN THE MID-VOWELS

This section examines the relationship between equivalence classification and (the absence of) new category formation in the Béarnais and French data sets. It also explores the linguistic processes of phonetic category assimilation (as a result of L2 sounds being subsumed by L1 categories) and phonetic category dissimilation (as a result of new category formation). Each of the equivalence classes identified will be examined separately, the Béarnais and French data sets for each class will be combined, and regression analyses including ‘language’ [Béarnais; French] as a fixed effect factor group will be used to establish significant variations in F1 and F2 that are related to cognate sounds being realised in one language or the other.

Appendix 4D includes mean F1-F2 plots for the ten individual bilingual speakers (female speakers A-E; male speakers F-J). Each plot includes mean values for mid-vowels and reference vowels as well as standard deviations for both French and Béarnais.

The Béarnais and French reference vowels /i/, /a/ and /u/ exhibit a one-to-one correspondence between the languages and would, on the basis of the SLM, be subject to equivalence classification. Regression analyses (with ‘speaker’ and ‘word’

as random effects) of F1 and F2 returned non-significant results for ‘language’ in all cases. This shows that there is no significant difference in pronunciation (in terms of vowel height or vowel frontness/backness) between Béarnais /i a u/ and French /i a u/. This finding provides evidence that the reference vowel pairs in each language are members of the same three phonetic categories [i], [a] and [u], and that, in each case, the diaphones ‘resemble each other in production’. The non-significant regression analyses are included in Appendix 4D.

FRONT MID-VOWELS

We have seen that Béarnais /e/ and /ɛ/ and French /e/ and /ɛ/ are hypothesised to be cognate phonemes in the bilinguals’ common phonological space. According to the SLM, these equivalence classifications will block new category for French /e/ and /ɛ/ and will lead to phonetic category assimilation whereby French /e/ is phonetically identical to Béarnais /e/ and French /ɛ/ is phonetically identical to Béarnais /ɛ/. In acoustic terms, the F1 and F2 values would not be significantly different in each of the languages for each of the vowels. We can test this hypothesis by combining the Béarnais and French data sets and using regression analysis to determine if there is a significant difference between /e/ in Béarnais and French, and /ɛ/ in Béarnais and French, focusing on the first two formant frequencies. These regression analyses control for inter- and intra-speaker variation as well as variability introduced into the data set by different lexical items, and all data used are normalised.

Beginning with /e/, the regression analysis for F1 is presented in Table 4.102. The analysis returned ‘language’ as a non-significant predictor of vowel height. This confirms that, on the basis of F1, Béarnais and French /e/ are not significantly different and do resemble each other in production. Table 4.103 presents the regression analysis for F2 where language is returned as a significant predictor of the variation observed ($p \leq 0.05$). Béarnais is shown to favour relatively lower F2 values while French favours higher F2 values. This means that French /e/ is significantly further forward in the vowel space than Béarnais /e/. If we examine the regression coefficients (± 0.07), the magnitude of this effect is very small: French /e/ is minutely fronter than Béarnais, but consistently so.

Dependent variable = F1 N = 376 Grand mean = -0.31	Deviance: 489 Degrees of freedom: 6
Non-significant factor groups were Language ($p=0.44$) and Speaker sex ($p=0.394$).	

Table 4.102. All speakers: Regression analysis for /e/: F1 values from Béarnais and French.

Dependent variable = F2 N = 376 Grand mean = 0.795		Deviance: 508 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.07	180	0.0323
	French	0.07	196	
Non-significant factor groups were Speaker sex (p=0.713).				

Table 4.103. All speakers: Regression analysis for /e/: F2 values from Béarnais and French.

The regression analysis for F1 in /ε/ is presented in Table 4.104. Language is returned as a non-significant factor group by the analysis, confirming that, as for /e/, no significant phonetic distinction is made between /ε/ in French and /ε/ in Béarnais

in terms of vowel height. Table 4.105 presents the same regression analysis for F2 whereby language is again returned as a non-significant predictor of variation in F2. This confirms that the bilingual speakers pronounce Béarnais /ɛ/ and French /ɛ/ in the same way. From the perspective of the SLM, the equivalence classification of Béarnais and French /ɛ/ means that they are present in a single phonetic category which is used to process and produce the perceptually linked L1 and L2 diaphones which also, as predicted, resemble each other in production. We may note, however, that the significance of ‘language’ as a predictor of F2 is just below the ($p \leq 0.05$) significance level ($p = 0.0541$). If we examine the regression coefficients for the ‘language’ factor group, we discover that the variation patterns in a similar way to F2 for /e/, above: French /ɛ/ is shown to be marginally further forward in the vowel space than Béarnais /ɛ/ with a similar magnitude effect (± 0.091).

Dependent variable = F1 N = 319 Grand mean = 0.409	Deviance: 639 Degrees of freedom: 6
Non-significant factor groups were Language ($p = 0.95$) and Speaker sex ($p = 0.168$).	

Table 4.104. All speakers: Regression analysis for /ɛ/: F1 values from Béarnais and French.

Dependent variable = F2 N = 319 Grand mean = 0.687	Deviance: 351 Degrees of freedom: 6
Non-significant factor groups were Language ($p = 0.0541$) and Speaker sex ($p = 0.114$).	

Table 4.105. All speakers: Regression analysis for /ɛ/: F2 values from Béarnais and French.

Cross-linguistically, there is no significant vowel height differences for the front mid-vowels between /e/ in Béarnais and French and between /ɛ/ in Béarnais and French but there are indications that the bilingual speakers distinguish these vowels in French and Béarnais by realising the French variants as (just) fronter than

Béarnais variants. There are many possible explanations for this. In both languages, from a language-internal perspective, /e/ is traditionally distinguished from /ɛ/ on the basis of F1 or vowel height. It is possible that the increased variability in F2 is present because it is not a primary dimension used to distinguish the front mid-vowels. In this way, the observations made here on the basis on the regression analyses of F2 for both front mid-vowels may not be particularly meaningful. According to the SLM, ‘the production of an L2 sound eventually corresponds to the properties present in its phonetic category representation’ (Flege, 1997:81). It is possible that the bilingual’s phonetic categories for /e/ and /ɛ/ are under-specified for vowel frontness (within certain margins) as a result of the fact that F1 is the most important factor in distinguishing the front vowel pairs (/e/ ~ /ɛ/) phonetically in both of their languages. Where vowel height is used for contrast, the L1 and L2 vowels are the same on this dimension but on the front/back dimension (which is not traditionally used for contrast), the L1 and L2 sounds are different and phonetic category assimilation has not (fully) taken place.

Finally, it is possible that the significant result for F2 is a manifestation of different phonetic realisation rules acting on a single ‘merged’ phonetic category for /e/. Flege notes that position sensitive allophones in the L1 and L2 can cause productions of a single merged phonetic category to differ in their phonetic realisation (1995a:98). In Béarnais, F2 in the front mid-vowels is not significantly affected by syllable type ($p=0.287$) (see Table 4.4). In the bilingual speakers variety of French, on the other hand, syllable type is a highly significant predictor of vowel frontness ($p\leq 0.01$) (see Table 4.60). Front vowels in open syllables were shown to be significantly fronter in French than vowels in closed syllables. This contextually

conditioned fronting in French is a phonetic realisation rule that distinguishes it from Béarnais. This may have caused the significant result suggesting a fronter /e/ in French than in Béarnais. Béarnais and French, however, also have different contextually conditioned allophones for F1 which govern alternations in vowel height. Durand notes that ‘Occitan’ varieties do not have an active *loi de position* while southern varieties of French retain the *loi de position* for the most part. Durand is of the opinion that, while it is possible that the vowel quality for French /e/ and /ɛ/ may well be transferred from ‘Occitan’ /e/ and /ɛ/, the syllabic distribution of the front mid-vowels in the various *langue d’oc* subsystems is so different from SF that bilingual speakers would necessarily abandon any contextual allophones of the mid-vowels of their L1 in their pronunciation of French, their L2 (2009:9). The regression analysis of F1 in the Béarnais front mid-vowels returned syllable type as non-significant (see Table 4.3). In French, on the other hand, the *loi de position* was shown to be a highly significant predictor of the variation observed (see Table 4.59). These differential allophonic ‘phonetic realisation rules’ did not, however, affect the F1 regression analyses for merged /e/ and merged /ɛ/ above.

If we examine the mean data points based on the raw data for /e/ (in Béarnais and French) for all speakers in Figures 4D.1 to 4D.10 (Appendix 4D, p. 551-553), we can observe that it is not true that French /e/ is fronter than Béarnais /e/ for all speakers (with the exception of Speaker C, Figure 4D.3). This confirms that the significant effect of language for F2 of /e/ is not consistent with the data.

In conclusion, this section has presented ample evidence to suggest that equivalence classification of French /e/ with Béarnais /e/ and French /ɛ/ with

Béarnais /ɛ/ has blocked new category formation and, in turn, has led to a situation where the bilingual Béarnais-French speakers use a single phonetic category for /e/ and a single phonetic category for /ɛ/ to process and produce the diaphones of their L1 and L2. Furthermore, the Béarnais and French variants of each of the phonetic categories have been shown to resemble each other in production, a diagnostic of cross-language phonetic category assimilation. This was shown to be primarily true for vowel height, while there was an indication that different language-specific phonetic realisation rules acting on merged phonetic categories may constitute an additional complicating factor for vowel frontness.

BACK MID-VOWELS

Working on the assumption that Béarnais /ɔ/ and French /O/ are cognate phonemes, this section tests the hypothesis that equivalence classification has blocked the formation of a new phonetic category for French /O/. The methodology employed will, as above, involve using a regression analysis including ‘language’ as a fixed effect factor group.

The regression analysis for F1 is presented in Table 4.106. ‘Language’ is returned as a highly significant predictor of F1 ($p \leq 0.001$): Béarnais /ɔ/ has significantly higher F1 values than French /O/ which favours lower F1 values. This shows that the Béarnais vowel is significantly lower than the French vowel. Similar regression analyses comparing (i) Béarnais /ɔ/ and French /ɔ/ and (ii) Béarnais /ɔ/ and French /o/ reveal the same pattern to be true in each case: Béarnais /ɔ/ is

significantly lower than all French back mid-vowels. These supplementary regression analyses are included in Appendix 4D.

Dependent variable = F1 N = 576 Grand mean = 0.067		Deviance: 1093 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	0.208	144	0.00016
	French	-0.208	432	
Non-significant factor groups were Speaker sex (p=0.2).				

Table 4.106. All speakers: Regression analysis for F1 values from Béarnais (/ɔ/) and French (/O/).

Table 4.107 presents the regression model for F2 where ‘language’ is also returned as a very highly significant predictor of vowel frontness ($p \leq 0.01$). Béarnais is shown to favour back vowels while French favours more centralised vowels. This is also true when Béarnais /ɔ/ is compared to French /ɔ/ and French /o/ separately (again, see Appendix 4D for supplementary regression models).

Dependent variable = F2 N = 576 Grand mean = -0.945		Deviance: 726 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.101	144	0.00138
	French	0.101	432	
Non-significant factor groups were Speaker sex (p=0.419).				

Table 4.107. All speakers: Regression analysis for F2 values from Béarnais (/ɔ/) and French (/O/).

The statistical analyses presented above reveal Béarnais /ɔ/ to be phonetically distinct from French /O/ on the basis of both F1 and F2: French /O/ is higher and more centralised than Béarnais /ɔ/. This shows that Béarnais /ɔ/ and

French /O/ are not members of the same phonetic category. From this, we must infer that a new phonetic category has been established for French /O/.

In Section 4.5.1.1 above, we demonstrated that French /ɔ/ and /o/ were merged into a single phonemic category, /O/, by analogy with the single back mid-vowel phoneme in Béarnais, and because the French phonetic contrast was not meaningful in the L1. This is an instance of phonological transfer but the findings above have shown phonetic transfer to be absent. We have seen that the greater the perceived dissimilarity of an L2 sound from the closest L1 sound, the more likely a new phonetic category will be formed for an L2 sound. We have also seen that Béarnais /ɔ/ is tightly clustered in the open-mid area of the vowel space (see Figures 4.3 and 4.5). It is possible that the wider range of variability, occupying the entire back mid-vowel space, in French /O/, triggered the establishment of a new phonetic category for the L2 due to the disaccord between the range on F1 values in each of the languages.

The establishment of a new phonetic category for French /O/ appears to have activated the linguistic mechanism of ‘phonetic category dissimilation’, whereby a newly established L2 category disperses in the bilingual vowel space and dissimilates from neighbouring L1 and/or L2 sounds to preserve phonetic contrast. In this case, the single French /O/ category has moved away from Béarnais /ɔ/ by raising and centralising. The new French /O/ phonetic category was perhaps also ‘attracted’ to the ‘gap’ in the asymmetrical L1 vowel space between Béarnais /ɔ/ and Béarnais /u/. It is also a possibility that the tight clustering of the Béarnais /ɔ/

vowel is a result of the L1 phonetic category also dissimilating, moving low in the vowel space to maximise phonetic contrast with the newly established L2 category for French /O/.

We have seen that Latin O became /u/ in Béarnais, but /ɔ/ in French. I have argued that bilingual speakers would, theoretically, be aware of the structural correspondences between these phonemic categories (see Section 2.4.1). This ‘awareness’ would be facilitated by the existence of lexical cognates in the L1 and L2 lexicons with a common root, e.g. Béarnais *sourélh* /su'reΔ/ and French ‘soleil’ /sɔlej/. Most SLM research thus far has focused on transfer between typologically dissimilar languages, at least when compared with the Béarnais-French contact situation. This supplementary awareness on the part of the bilingual of one-to-one structural correspondences means that, in addition to the equation of L2 sounds with L1 sounds in an absolute phonetic manner, there is an equation of L2 sounds with phonetically different L1 sounds that share a similar (or identical) phonological distribution in both of the languages. Following this argument, the raising of the newly formed French /O/ category, or indeed the raising of French /ɔ/ to merge phonetically with French /o/, may be due to the phonetic attraction of French /o/ and /ɔ/ to Béarnais /u/. The Béarnais [u] phonetic category is actually, of course, a single Béarnais-French [u] phonetic category, as demonstrated statistically at the beginning of Section 4.5.1.2. While it is difficult to demonstrate conclusively that this is the case, we must bear this possibility in mind. It is likely to be a combination of absolute phonetic association and structural phonological correspondences that has led to the phonetic category dissimilation witnessed here for French /O/. Flege

does in fact acknowledge the importance of structural relatedness where the languages correspond directly, stating that the principle of ‘under-differentiation’ may apply variably: if, for a given pair of phonemic cognates in the L2 and the L1, the perceptual dissimilarity between their realisations is great, the L2 phoneme may be assigned to the phonetic category of a sound with which it has no structural relation (Flege, 1995b:265). Perhaps, the phonetic dissimilarity between Béarnais [u] (or merged [u]) and French [ɔ] caused the latter to be assigned to a new phonetic category, merging it with French [o], to form French [O] which is, in turn, linked perceptually to Béarnais [ɔ] because it is phonetically more similar.

As for the front mid-vowels, we can also examine the phonetic realisation rules that act on the Béarnais /ɔ/ and French /O/ phonetic categories to output the respective vowels motorically. This investigation will, once again, focus on contextual allophones conditioned by varying syllable types. Beginning with Béarnais /ɔ/, syllable type was shown to be a highly significant predictor of vowel height for all speakers ($p < 0.01$) (see Table 4.7) while there was no significant syllable type effect on F2 (see Table 4.8). If we examine only stressed vowels, final closed syllables favour open vowels while medial open syllables, which also favour open vowels, showed a smaller magnitude effect. We can note that unstressed syllables in Béarnais favour higher vowels. For French /O/, syllable type is returned as a highly significant predictor of both F1 and F2 ($p < 0.01$) (see Tables 4.61 and 4.62). For F1, the *loi de position* is shown to be active as a phonetic realisation rule: final closed syllables favour more open vowels than open syllables, which favour close vowels. The phonetic realisation rules, or *loi de position*, act on one L2

phonemic category, French /O/, which occupies the close-mid area of the bilingual vowel space. This means that the open-close alternations in French /O/, linked to the *loi de position*, occur within a restricted area of the vowel space and do not utilise the entire range (because the open-mid area of the vowel space is occupied by Béarnais /ɔ/). The contextual open and close variants of French /O/ will thus necessarily differ from monolingual (and particularly northern) French norms. We may note that this concurs with Carton et al.'s observation which describes the open [ɔ] variant in Gascony as not being *as open* as the /ɔ/ of SF but somewhere between [o] and [ɔ] (1983:61). F2 is also conditioned by syllable type for French /O/: medial syllables favour centralised vowels while final syllables favour back vowels. It is possible that this alternation, and the subsequent expansion of the /O/ distribution by the centralisation of medial vowels, has led to the significant phonetic distinction between French /O/ and Béarnais /ɔ/ on the front-back dimension. We must note that exceptions to the *loi de position* in SF, such as /o/ in syllables closed by /z/, are overwhelmingly realised in line with the *loi de position* by older bilingual speakers (e.g., ‘rose’ /roz/ as [rɔːz], ‘pauvre’ /povʁ/ as [pɔːvr] etc.): the *loi de position* can be seen to ‘override’ the standard specification for an close vowel [o]. This also causes standard contrasts in final closed syllables to be neutralised (e.g. ‘saute’~‘sotte’). Indeed, it is possible that the input variety of French did not contain such a specification, in which case there is no specification to override, the *loi de position* simply applies in a regular fashion. This feature is, in fact, widely attested in

southern varieties of French and is highly frequent in the speech of all generations, even young educated urbanites.

Finally, we can look at the raw data for individual male and female speakers in Figures 4D.1 to 4D.10 (Appendix 4D, p. 551-553). The results described above, which indicated the existence of one Béarnais /ɔ/ phonetic category and one French /O/ phonetic category, are true for the following female and male speakers: Speakers B, C and D; Speakers G, I and J. Each of these speakers exhibits separation between Béarnais /ɔ/ and phonetically overlapping French (/ɔ/ and /o/). For the four remaining speakers, three different patterns are evident. Speaker A exhibits overlapping distributions for Béarnais /ɔ/ and French /ɔ/, with relative phonetic separation for French /o/, which is higher in the vowel space. Based on the SLM, we may conclude that Speaker A is using a merged [ɔ] phonetic category which processes and produces /ɔ/ for the L1 and the L2. Additionally, a new category has been formed for French /o/ which may have been learned as new exemplars of French /o/ where acquired over the speaker's lifetime or /o/ may have been judged as sufficiently phonetically different from /ɔ/ to establish a new phonetic category from the outset. Another system that emerges from the raw data is that of Speaker E and Speaker H: three phonetic categories form a continuum (Béarnais [ɔ]–French [ɔ]–French [o]). In fact, it is not clear, from the perspective of the SLM, whether to interpret this system as a single merged phonetic category (due to the high levels of standard deviation overlap) which utilises different phonetic realisation rules to output the vowels motorically, or, whether three phonetic categories have been

established (since they are not completely phonetically distinct in each case). Finally, Speaker F appears to use one phonetic category for all three L1 and L2 vowels. Put another way, equivalence classification has caused the L1 category for Béarnais /ɔ/ to subsume both French /ɔ/ and French /o/, leading to cross-language phonetic category assimilation which has resulted in all three vowels being realised as phonetically the same (cf. Carton et al., 1983; Moreux, 2006; see Section 2.3.1.1). Despite these idiosyncratic differences, the regression models presented above are nonetheless robust as ‘speaker’ was always included as a random effect: the models controlled for individual variation and returned significant effects for fixed effects only when they were more significant than inter-speaker variation.

Overall, phonemic transfer has not resulted in phonetic transfer for the majority of older bilingual speakers. The majority pattern showed the establishment of a new phonetic category for French /O/ which dissimilated phonetically from Béarnais /ɔ/ by raising and centralising, with some individual speakers also showing idiosyncratic patterns. The influence of structural, rather than absolute (phonetic) cognates, on transfer was also discussed, leading to a conclusion that the raising of French [O] by phonetic category dissimilation was likely a result of deflection from Béarnais [ɔ] and attraction to merged [u]. We have also seen that Béarnais /ɔ/ and French /O/ are subject to varying contextual constraints on F1 and, to a lesser extent, F2, which shows that the different phonetic categories are realised motorically using different sets of rules.

4.5.2 TRANSFER IN THE NASAL UNITS

An analysis of phonological and phonetic transfer between the Béarnais nasal unit system, /iN ỹN ěN ãN ũN/, and the nasal vowel system of French, /ẽ œ ã õ/, is problematic from the outset because there is no one-to-one phonetic or phonological correspondence between all of the elements of the respective systems. This section will, necessarily, adopt a more complex approach to investigating transfer than that presented for the mid-vowels in Section 4.5.1. Firstly, the analysis of phonological transfer examines the (various) ways in which the Béarnais and French systems may, in the absence of obvious candidates for equivalence classification, be equated structurally and phonetically. This discussion outlines the predictions of the SLM for each of the possible scenarios in turn: underlying phonemic category association; under-differentiation; new category formation. Secondly, lexical and contextual constraints on nasal consonant coda presence in Béarnais and French are discussed, assessing evidence for the replication of the lexically defined system of the former in the latter. Finally, the analysis of phonetic transfer investigates empirically these (possible) relationships and models statistically the complex links between the phonetic and phonological components of the bilingual system. The phonetic analysis focuses on F1, F2, and (where necessary) F3.

4.5.2.1 PHONOLOGICAL TRANSFER IN THE NASAL UNITS

Flege's SLM would assume the Béarnais and French nasal units to exist in a common phonological space. Based on these assumptions, and on the predictions of the SLM, we can identify (at least) three possible mechanisms via which the Béarnais and French systems may be related:

- (1) Equivalence classification: components of the L1 and L2 systems are associated based on their equivalent representations in their respective phonologies.
- (2) Under-differentiation: for a given pair of phonemic cognates in the L2 and the L1, if the perceptual dissimilarity between their realisations is great, the L2 phoneme may be assigned to the phonetic category of a phoneme with which it has no structural relation.
- (3) New category formation: perceptual dissimilarity between L2 and L1 phonetic categories will block equivalence classification and cause the formation of new L2 phonetic categories.

‘Equivalence classification’, is the most abstract mechanism by which the components of the Béarnais and French systems may be equated. As argued above, the typological similarity between Béarnais and French facilitates the direct association of equivalent phonemes or sequences of phonemes: in lexical cognates with common Latin etyma, phonemic units may be equated in common phonological space. This process, which acts between all elements of the lexicon on a large scale, provides the bilingual speaker with a latent awareness of the structural correspondences between phonological and phonetic components of each of their languages. For example, Béarnais *bén* /bēn/ would be associated with French ‘vent’ /vā/ leading to the association of Béarnais /b/ and /ēN/ with French /v/ and /ā/ respectively. This process may involve more complex associations involving sequences of phonemes such as the association of Béarnais *hê* /hēN/ with French ‘foin’ /fwē/: Béarnais /h/ and /ēN/ are equated with French /f/ and /wē/ respectively.

From a phonological perspective, the following nasal phonemic cognate pairs are possible between Béarnais and French, noting again that there is no one-to-one correspondence between all components of the phonological systems:

French	Béarnais
/ɛ̃/	/iN/
/ɛ̃/	/ẽN/
/ɛ̃/	/ãN/
/œ̃/	/ỹN/
/ã/	/ẽN/
/ã/	/ãN/
/õ/	/ũN/

From a phonetic perspective, the situation is, of course, much more complex involving multiple permutations of the primary variable parameters (vowel quality, nasalisation, nasal consonant codas) present in each language.

We know that the French nasal vowels are regularly found in allomorphic alternations with vowel plus nasal consonant (VN) sequences (from Latin open syllables), e.g. *plein* /plẽ/ and *pleine* /plẽN/. The following allomorphic alternations are possible in (conservative standard) French:

Ŵ	VN
/ɛ̃/	/iN/
/ɛ̃/	/ɛN/
/ɛ̃/	/eN/ ND
/ɛ̃/	/aN/
/ɛ̃/	/əN/ ND
/œ̃/	/yN/
/œ̃/	/øN/ ND
/ã/	/ɛN/
/ã/	/aN/
/ã/	/əN/ ND
/õ/	/ɔN/

In the French data set, all words containing nasal vowels for which an allomorphic alternation is known to exist (e.g. ‘fin’ /fɛ̃/ and ‘fine’ /fin/) could be recoded to include information on the alternating form. Words for which an allomorphic alternation was ambiguous or non-existent (e.g. ‘foin’ /fwɛ̃/) could not be included in this recode. While this would involve excluding potentially large portions of the data, to include such forms would be theoretically problematic given that it is not possible to state unambiguously the correspondences between the allomorphic pairs on the basis of surface phonology alone (Ayres-Bennett et al., 2001:83). VN sequences marked with (ND) were not attested in the French data set and it would thus be impossible to include them as categories in the recode. The resulting recoded subset of the French data could be classified into five alternating categories: /iN/, /yN/, /ɛN/, /aN/, and /ɔN/. These potential alternating categories reveal, more clearly, the structural correspondences between the Béarnais and French systems, as represented graphically in Figure 4.41.

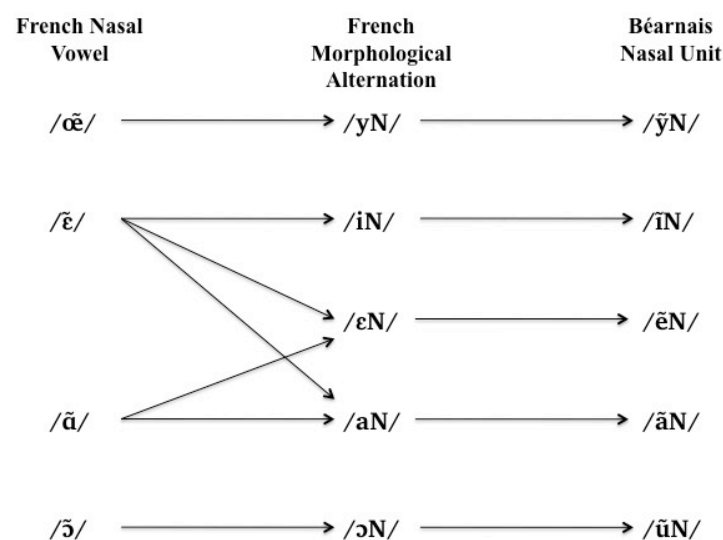


Figure 4.41. Underlying ‘phonemic cognate’ relationship between the Béarnais nasal units and the French nasal vowels.

Figure 4.41 shows that French /œ/ and /ɔ/ alternate exclusively with the VN sequences /yN/ and /ɔN/ which, in turn, map directly onto the Béarnais nasal units /ỹN/ and /ũN/ respectively. This means that there is a one-to-one correspondence between French /œ/ and Béarnais /ỹN/ and between French /ɔ/ and Béarnais /ũN/: they are unambiguous phonemic cognates from a structural perspective. French /ɛ/ can map onto Béarnais /iN/, /ẽN/ or /ãN/ depending on the allomorphic alternation involved. Similarly French /ã/ can map onto Béarnais /ẽN/ or /ãN/. If /ɛ/ and /ã/ are derived from the alternating VN forms, their structural association with the corresponding Béarnais nasal units may be unproblematic for the bilingual. Based on Figure 4.41, we can group the nasal units into sub-categories, based on their structural associations: ‘unambiguous phonemic cognates’ and ‘ambiguous phonemic cognates’.

Prediction two, under-differentiation, is perhaps a more likely scenario for the ambiguous phonemic cognates. According to this principle, the L2 sounds (French /ɛ/ and /ã/) would be dissociated from their underlying structural equivalents in the L1 (/iN/, /ẽN/, /ãN/ for French /ɛ/ and /ẽN/, /ãN/ for French /ã/) and assigned to the nearest perceptually similar phonetic category in the L1. If under-differentiation is the mechanism governing transfer for the ambiguous nasal units, we might expect French /ɛ/ to be processed and produced as an instance of the Béarnais [ẽN] phonetic category given their ‘perceptual’ similarity. Likewise, we might expect French /ã/ to be realised as an instance of the Béarnais [ãN] phonetic category.

Finally, it is possible the French /ẽ/ and /ã/ will form new phonetic categories in the bilingual vowel space either because they are judged to be sufficiently phonetically different from any L1 phonetic categories or because of the opacity of the complex structural relationship between the French and Béarnais systems for these nasal units. This relationship may inhibit equivalence classification and instigate new category formation.

We have previously noted that nasal consonant codas in Béarnais nasal units are lexically defined: nasal consonants are present in medial syllables, e.g. *crampe* /'krãmpɔ/, and closed final syllables, *téms* /'tẽms/; nasal consonants may or may not occur in final open syllables, e.g. *plâ* /plã/ and *poun* /pun/. In French, on the other hand, the appearance of a nasal consonant following a phonemically nasal vowel is variable synchronically. The statistical analysis of this variability revealed that the presence of a nasal consonant was the majority form for all syllable types with the following constraints on variation: nasal consonant presence is favoured by medial open, e.g. 'chantait' /ʃãtɛ/ [ʃãnte], and final closed syllables, e.g. 'cinq' /sẽk/ [sẽŋk]; the absence of a nasal consonant is favoured in final open syllables, e.g. 'bonbon' /bõbõ/ [bõmbõ]. It appears that the historical constraints of the Béarnais system are, to a certain extent, replicated in RF but this is by no means categorical. The tendency for nasal consonants to occur as the majority variant in all positions is however modified significantly by constraints in the L2 that resemble the pattern present in the L1.

The existence of lexical cognates between French and Béarnais may cause the appearance of the Béarnais lexical distribution for nasal consonant codas, /ṽN/

or / $\tilde{v}$ /, in equivalent French words as [$\tilde{v}$ N] or [$\tilde{v}$]. In the absence of one-to-one lexical equivalents in the Béarnais and French data sets, it is not possible to test transfer of the lexical distribution empirically. Therefore, the phonetic analysis of transfer in the following sections will examine transfer of vowel quality from Béarnais [$\tilde{v}$ N] (sequential units) to French [$\tilde{v}$ N] (sequential units) and from Béarnais [$\tilde{v}$] (non-sequential units) to French [$\tilde{v}$] (non-sequential). This assumes the underlying representation for all French and Béarnais lexical items to be / $\tilde{v}$ N/ even though there are cases in both languages where there is no surface evidence for underlying vowel plus nasal consonant sequences. Since, however, the division of the Béarnais and French data sets into sequential and non-sequential units aimed to control for the effect of consonant presence on formant frequencies, I would argue that an investigation of transfer in vowel quality is not problematic in this respect as the phonetic environment is held constant. This assumption is, however, problematic for analysing transfer of consonant codas but, in any case, the constraints on variation in consonant presence have been shown to be different in French, suggesting that there is no one-to-one transfer for equated lexemes in both of the languages.

4.5.2.2 PHONETIC TRANSFER IN THE NASAL UNITS

This section investigates empirically transfer between the nasal unit system of Béarnais and the French nasal vowel system. We have seen that there are various possible ways in which the two divergent systems may be equated: underlying structural equivalence classification; phonetic category assimilation via under-differentiation; new category formation. The analyses presented here will test the

various competing hypotheses advanced for unambiguous and ambiguous phonemic cognates focusing the analysis on vowel quality. F1 and F2 will form the basis of the statistical analysis for all nasal units with F3 featuring only in the statistical analyses of the unambiguous phonemic cognates (where lip-rounding is a specified feature). The analyses presented here will examine transfer from Béarnais sequential nasal units to French sequential units and from Béarnais non-sequential nasal units to French non-sequential units.

As was the case for the mid-vowels, regression models using ‘language’ as a fixed effect (and controlling for ‘speaker’ and ‘word’ as random effects), will be used to establish if a French phonetic category is realised as an instance of a (structurally related or perceptually similar) Béarnais phonetic category: this will determine if the pronunciations in each of the languages are significantly different for pairs of sounds that we expect to be structurally or phonetically correlated, according to the SLM. Note that these analyses compare the surface forms of the French nasal vowels to those of the Béarnais nasal units using the entire French data set (including the nasal vowels for which allomorphic alternations do not exist). The inclusion of non-alternating forms in the French data set is not problematic for the regression analyses as they do not assume the underlying correspondences outlined in Figure 4.41 to be true, they simply examine the actual phonetic difference between phonetic realisations in the surface phonologies, such as between French [ẽ] and Béarnais [ẽ̃].

The French nasal vowels /œ̃/ and /ɔ̃/ have been shown to exhibit a one-to-one correspondence with the Béarnais nasal units /ỹN/ and /ũN/, respectively, from a structural perspective. The SLM would predict the following outcomes for transfer:

- 1) Phonetic category assimilation: If phonetic category assimilation has taken place, then the F1, F2 and F3 values for Béarnais /ỹN/ and French /œ̃/ and for Béarnais /ũN/ and French /ɔ̃/ respectively will not be significantly different.

or

- 2) New category formation: If new category formation has taken place, then the F1, F2 and F3 values for Béarnais /ỹN/ and French /œ̃/ and for Béarnais /ũN/ and French /ɔ̃/ respectively will be significantly different.

French /œ̃/ and Béarnais /ỹN/

Beginning with sequential nasal units, the mixed-effects regression models including ‘language’ [Béarnais; French] as a fixed effect factor group could not distinguish significantly between F1 and F2 values based on the information about the language a token was realised in alone ($p=0.015$ and $p=0.634$, respectively). The non-significant regression models may be consulted in Appendix 4E. This provides evidence for phonetic category assimilation, which supports prediction (1), above: in sequential nasal units, French /œ̃/ and Béarnais /ỹN/ are not significantly different in terms of vowel height or vowel frontness/backness. Their association as an equivalence class appears to have facilitated their resemblance phonetically. The

regression model for F3 did, however, return ‘language’ as a highly significant predictor ($p=0.00777$). This model is presented in Table 4.108 below. Béarnais is shown to favour lower F3 values than French. The magnitude of this effect is relatively large, indicating perhaps that more rounding is present for Béarnais / $\tilde{y}N$ / than for French / œ / which distinguishes them phonetically. Given that we may expect more open vowels to be less rounded and that there is no significant difference in vowel height between the Béarnais and French vowels, it is interesting to note the F3 distinction between the vowels. Overall, we can conclude that, in sequential nasal units, French / œ / and Béarnais / $\tilde{y}N$ / are not completely the same phonetically in that they differ in their F3 values.

Dependent variable = F3 N = 285 Grand mean = -0.29		Deviance: 622 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.132	131	0.00777
	French	0.132	154	
Non-significant factor groups were Speaker sex (p=0.361).				

Table 4.108. All speakers: Regression analysis for F3 values from Béarnais (/ $\tilde{y}N$ /) and French (/ œ /) (sequential nasal units).

In non-sequential nasal units, ‘language’ is returned as a significant predictor of F1 and F3 for the phonemic cognates ($p=0.0154$ and $p=0.0345$, respectively). ‘Language’ is not found to be a significant predictor of F2, however ($p=0.567$). The regression models for F1 and F3 are presented in Tables 4.109 and 4.110 and the model for F2 may be consulted in Appendix 4E. These results provide evidence for prediction (2), new category formation. For F1, Béarnais favours significantly lower values than French: / $\tilde{y}N$ / is significantly higher than / œ / in the vowel space. This finding coincides with their impressionistic representations as close and open-mid

vowels respectively. F2 was found to be ‘the same’ for French /œ̃/ and Béarnais /ỹN/ but this does not provide substantial evidence for phonetic category assimilation, given that they are both front vowels and we would expect them to be similar on the basis of F2. The F3 distinction presented above for sequential nasal units is again returned as significant for non-sequential units: Béarnais favours lower F3 values than French, perhaps indicating more rounding for Béarnais /ỹN/ than for French /œ̃/ which, in the case of non-sequential nasal units, shows the expected relationship between rounding and vowel height given that Béarnais /ỹN/ is also higher than French /œ̃/.

Dependent variable = F1 N = 100 Grand mean = -0.595		Deviance: 112 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.152	70	0.0154
	French	0.152	30	
Sex	Male	-0.154	41	0.039
	Female	0.154	59	

Table 4.109. All speakers: Regression analysis for F1 values from Béarnais (/ỹN/) and French (/œ̃/) (non-sequential nasal units).

Dependent variable = F3 N = 100 Grand mean = -0.31		Deviance: 195 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.206	70	0.0345
	French	0.206	30	
Non-significant factor groups were Speaker sex (p=0.288).				

Table 4.110. All speakers: Regression analysis for F3 values from Béarnais (/ỹN/) and French (/œ̃/) (non-sequential nasal units).

Overall, the statistical analysis presented here provides evidence to suggest that equivalence classification of Béarnais /ỹN/ with French /œ/ has led to a certain degree of phonetic category assimilation in sequential units (but F3 is significantly different in each of the languages). In non-sequential nasal units, on the other hand, new category formation appears to have taken place: French /œ/ is significantly phonetically different from Béarnais /ỹN/. Thus, nasal consonant codas appear to favour phonetic category assimilation while their absence favours new category formation for L2 sounds. This means that when a French /œ/ is realised with a nasal consonant coda, it is phonetically much more similar to Béarnais /ỹN/ than when it is not: [œN] is more phonetically similar to [ỹN] than [œ] is to [ỹ].

French /õ/ and Béarnais /ũN/

We can now test the specific SLM derived hypotheses for transfer between the second unambiguous phonemic cognate pair, French /õ/ and Béarnais /ũN/. For sequential and non-sequential units, the regression models for the first three formant frequencies return ‘language’ as a non-significant predictor of F1 but as a significant predictor of both F2 and F3. For F1, information about whether a F1 token was from French /õ/ or Béarnais /ũN/ was insufficient to predict the values observed (p=0.693 for sequential units; p=0.16 for non-sequential units). We would expect vowel height to be the primary phonetic distinction between these sounds given that they are both back rounded vowels. The F1 phonetic assimilation of French /õ/ and Béarnais /ũN/ may be due to equivalence classification at a structural level: raising of French /õ/ and lowering of Béarnais /ũN/ would be facilitated by the mechanism of cross-

language phonetic category assimilation (the phonetic categories in each of the languages are ‘attracted’ to each other).

Tables 4.111 and 4.112 present the F2 regression models for sequential and non-sequential nasal units. In both cases, ‘language’ is shown to be highly significant predictor of vowel frontness/backness ($p=1.34e-05$; $p=2.53e-07$): Béarnais / $\ddot{u}$ N/ is significantly more back (has significantly lower F2 values) than French / $\ddot{o}$ /.

Dependent variable = F2 N = 391 Grand mean = -1.067		Deviance: 650 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.227	74	1.34e-05
	French	0.227	317	
Non-significant factor groups were Speaker sex (p=0.723).				

Table 4.111. All speakers: Regression analysis for F2 values from Béarnais (/ $\ddot{u}$ N/) and French (/ $\ddot{o}$ /) (sequential nasal units).

Dependent variable = F2 N = 147 Grand mean = -1.105		Deviance: 242 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.366	65	2.53e-07
	French	0.366	82	
Non-significant factor groups were Speaker sex (p=0.219).				

Table 4.112. All speakers: Regression analysis for F2 values from Béarnais (/ $\ddot{u}$ N/) and French (/ $\ddot{o}$ /) (non-sequential nasal units).

The results for F3 display a similar pattern (in Table 4.113 for sequential units and in Table 4.114 for non-sequential units) with significantly lower F3 values for Béarnais / $\ddot{u}$ N/ across the board. It is possible that the lower F2 and F3 values in Béarnais are an acoustic consequence of increased lip-rounding relative to French / $\ddot{o}$ /. In any

case, the phonetic categories for each of the phonemic cognates are distinct for both F2 and F3.

Dependent variable = F3 N = 391 Grand mean = -0.264		Deviance: 1007 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.46	74	2.28e-10
	French	0.46	317	
Non-significant factor groups were Speaker sex (p=0.7).				

Table 4.113. All speakers: Regression analysis for F3 values from Béarnais (/ũN/) and French (/ɔ̃/) (sequential nasal units).

Dependent variable = F3 N = 147 Grand mean = -0.428		Deviance: 362 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.208	65	0.0433
	French	0.208	82	
Non-significant factor groups were Speaker sex (p=0.772).				

Table 4.114. All speakers: Regression analysis for F3 values from Béarnais (/ũN/) and French (/ɔ̃/) (non-sequential nasal units).

The results presented here support prediction (2) for the most part: a new phonetic category has been established for French /ɔ̃/. There is however some evidence to suggest that the mechanism of cross-language phonetic category assimilation is active because no significant phonetic difference is made between the cognate phonemes on the basis of vowel height. This finding supports the hypothesis that Béarnais /ũN/ and French /ɔ̃/ are equated structurally, even if evidence for equivalence classification leading to complete phonetic category assimilation is lacking. The patterns presented here also appear to be equally true for the phonemic cognates when they occur with or without a nasal consonant coda.

AMBIGUOUS PHONEMIC COGNATES

For the phonemic cognates that exhibit complex structural relations at a phonemic category level, French /*ẽ*/ and /*ã*/ and the Béarnais nasal units /*ĩN*/, /*ẽN*/ and /*ãN*/, the SLM predicts (at least) two different outcomes at the phonetic category level:

- 1) Under-differentiation: If under-differentiation has taken place, then the F1, F2 and F3 values for Béarnais /*ẽN*/ and French /*ẽ*/ and for Béarnais /*ãN*/ and French /*ã*/ respectively will not be significantly different (phonetic category assimilation).

or

- 2) New category formation: If new category formation has taken place then the F1, F2 and F3 values for Béarnais /*ẽN*/ and French /*ẽ*/ and for Béarnais /*ãN*/ and French /*ã*/ respectively will be significantly different.

Each of these possible language contact outcomes will be considered separately below for French /*ẽ*/ and its nearest perceptual L1 category, Béarnais /*ẽN*/, and for French /*ã*/ and its nearest perceptual L1 category, Béarnais /*ãN*/. Note, again, that the structural correlations between these perceptual pairs are not in one-to-one correspondence.

French /*ẽ*/ and Béarnais /*ẽN*/

Beginning with sequential nasal units, Tables 4.115 and 4.116 present the mixed-effects regression models including ‘language’ as a fixed effect predictor for F1 and F2 values respectively. In both cases, the French and Béarnais F1 and F2 values are highly significantly different ($p=2.93e-05$ for F1; $p=1.52e-06$ for F2): Béarnais /*ẽN*/

vowels are lower and more centralised than French /*ẽ*/ vowels in sequential units.

The results suggest that the L2 sound has formed a new phonetic category as a result of perceptual dissimilarity with its nearest phonetically similar L1 category.

Dependent variable = F1 N = 388 Grand mean = -0.179		Deviance: 731 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	0.179	123	2.93e-05
	French	-0.179	265	
Non-significant factor groups were Speaker sex (p=0.856).				

Table 4.115. All speakers: Regression analysis for F1 values from Béarnais (/ẽN/) and French (/ẽ/) (sequential nasal units).

Dependent variable = F2 N = 388 Grand mean = 0.881		Deviance: 754 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.265	123	1.52e-06
	French	0.265	265	
Non-significant factor groups were Speaker sex (p=0.744).				

Table 4.116. All speakers: Regression analysis for F2 values from Béarnais (/ẽN/) and French (/ẽ/) (sequential nasal units).

In non-sequential units, on the other hand, regression models for F1 and F2 return ‘language’ as a non-significant predictor of the variation observed (p=0.871 for F1; p=0.279 for F2). These non-significant regression models can be consulted in Appendix 4E. This result shows that there is no significant vowel height or vowel frontness/backness difference between Béarnais /ẽN/ and French /ẽ/. This provides evidence for the mechanism of under-differentiation in non-sequential units: French /ẽ/ does not appear to be equated structurally with Béarnais /ĩN/, /ẽN/, and /ãN/, but instead with its nearest perceptually similar phonetic category, Béarnais [ẽN].

This under-differentiation has subsequently lead to phonetic category assimilation whereby French [ɛ̃] and Béarnais [ẽ] now resemble each other in production.

Differing phonetic structures (presence/absence of a nasal consonant) appear to condition transfer in separate ways leading to both new category formation and under-differentiation. This means that French [ɛ̃N] is different to Béarnais [ẽN] while French [ɛ̃] and Béarnais [ẽ] were not shown to be significantly different. The opposite pattern, phonetic category assimilation in sequential nasal units and new category formation in non-sequential units, was observed above for French /œ̃/ and Béarnais /ỹN/.

French /ã/ and Béarnais /ãN/

We can now examine the alternative hypotheses for French /ã/ and Béarnais /ãN/.

For both phonetic environments, French /ã/ and Béarnais /ãN/ are significantly different in terms of both F1 and F2. The regression models for F1 in sequential and non-sequential units are presented in Tables 4.117 and 4.118, respectively. In both phonetic structures, Béarnais /ãN/ is highly significantly lower in the vowel space than French /ã/. The magnitude of this effect is large and the associated probabilities are strong ($p=8.01\text{e-}07$ for sequential units; $p=0.000797$ for non-sequential units).

Dependent variable = F1 N = 425 Grand mean = 0.994		Deviance: 1015 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	0.47	83	8.01e-07
	French	-0.47	342	
Non-significant factor groups were Speaker sex (p=0.0612).				

Table 4.117. All speakers: Regression analysis for F1 values from Béarnais (/ãN/) and French (/ã/) (sequential nasal units).

Dependent variable = F1 N = 135 Grand mean = 1.168		Deviance: 327 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	0.534	56	0.000797
	French	-0.534	78	
Non-significant factor groups were Speaker sex (p=0.746).				

Table 4.118. All speakers: Regression analysis for F1 values from Béarnais (/ãN/) and French (/ã/) (non-sequential nasal units).

The regression models for F2 are presented in Tables 4.119 and 4.120 for sequential and non-sequential nasal units. Again, ‘language’ is a significant predictor of the variation observed in both phonetic environments: Béarnais /ãN/ is significantly further back in the vowel space than French /ã/. This effect is of high magnitude and significance for sequential nasal units.

Dependent variable = F2 N = 425 Grand mean = -0.108		Deviance: 633 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.209	83	3.1e-05
	French	0.209	342	
Non-significant factor groups were Speaker sex (p=0.243).				

Table 4.119. All speakers: Regression analysis for F2 values from Béarnais (/ãN/) and French (/ã/) (sequential nasal units).

Dependent variable = F2 N = 135 Grand mean = -0.334		Deviance: 185 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.146	56	0.0312
	French	0.146	78	
Non-significant factor groups were Speaker sex (p=0.75).				

Table 4.120. All speakers: Regression analysis for F2 values from Béarnais (/ãN/) and French (/ã/) (non-sequential nasal units).

The evidence presented here suggests that French /ã/ has formed a new phonetic category, distinct from Béarnais /ãN/ by being more centralised on the height dimension and further forward in the vowel space. There is no evidence to suggest that under-differentiation has led to the equation of French /ã/ and Béarnais /ãN/ and these results are consistently significant for both phonetic structures (when a nasal consonant coda is both present and absent).

SUMMARY OF PHONETIC TRANSFER (NASAL UNITS)

At the beginning of this section, I advanced the hypothesis that the Béarnais nasal unit and French nasal vowel systems may be equated in terms of underlying VN sequences because structural correlations between the systems cannot be discerned unambiguously on the basis of their surface phonologies alone (at least for French /ẽ/ and /ã/ with Béarnais /ĩN/, /ẽN/, and /ãN/). Given the structural dissimilarity between the Béarnais and French systems, the SLM posits that either a new French sound will be assigned to its nearest perceptually similar phonetic category (with concomitant disregard for underlying structural correspondences) or that the French sound will form a new phonetic category that is different from all existing L1 categories. These competing hypotheses were analysed statistically for unambiguous and ambiguous phonemic cognates, the latter being compared to their nearest perceptually similar L1 phonetic categories. The results of this analysis were

	/œ/ and /ỹN/	/õ/ and /ũN/	/ẽ/ and /ẽN/	/ã/ and /ãN/
[ỹN]	Phonetic Category Assimilation	New Category Formation*	New Category Formation	New Category Formation
[ẽ]	New Category Formation	New Category Formation*	Phonetic Category Assimilation	New Category Formation

Overall, there is no unambiguous-ambiguous split governing the SLM mechanism which facilitates transfer (phonetic category assimilation) or blocks transfer (new category formation). The majority pattern is new category formation for L2 (French) sounds. This is not surprising given the disaccord between the surface phonologies of the Béarnais and French systems. Two instances of transfer were, however, identified. Firstly, French /œ/ and Béarnais /ỹN/ are phonetically ‘the same’, or are realised as variants of a single bilingual phonetic category, only when they occur with a nasal consonant coda. These phonemic cognates exhibit a one-to-one structural correspondence. Secondly, French /ẽ/ and Béarnais /ẽN/ are realised as instances of a single phonetic category when they occur with no nasal consonant coda. The existence of /ẽ/ and /ẽN/ as an equivalence class is a case of under-differentiation. Finally, we may note that for the French /õ/ and Béarnais /ũN/ phonemic cognates (*), which exhibit one-to-one structural correspondence, the L2 and L1 sounds were phonetically assimilated for F1, the primary dimension for distinguishing them in impressionistic terms. F2 and F3 values were, however, significantly different for the cognates and thus ‘complete’ phonetic category assimilation cannot be said to have taken place.

4.6 CHAPTER SUMMARY

The analysis presented in this chapter, for the mid-vowels and nasal units, served to document variation in both Béarnais and French for the bilingual speakers: for each language, the phonetic and phonological inventories were presented and compared to traditional impressionistic schemata.

The application of Flege's SLM to the variation observed allowed the analysis to examine both phonological and phonetic transfer from Béarnais into French and to identify the linguistic mechanisms facilitating or inhibiting the transfer of substrate features into RF.

For the mid-vowels, a qualitative analysis established three potential equivalence classes: Béarnais /e/ and French /e/; Béarnais /ɛ/ and French /ɛ/; Béarnais /ɔ/ and French /O/. The mechanism of phonetic category assimilation was shown to be active for the front mid-vowels: it appeared that the vowels in both languages were realised as instances of L1 phonetic categories. The establishment of French /O/, which conflates /o/ and /ɔ/, by analogy with Béarnais /ɔ/ was shown to be a case of phonological substrate transfer but the association of these vowels as an equivalence class did not lead to phonetic category assimilation: the establishment of a new phonetic category for French led, conversely, to phonetic category dissimilation, with French /O/ raising and centralising in the bilingual vowel space.

The complex structural and surface phonological relationships between the Béarnais and French nasal units required the transfer analysis to identify unambiguous and ambiguous phonemic cognates or equivalence classes. There was more evidence for phonetic transfer, via phonetic category assimilation, when there existed a one-to-one correspondence between the surface phonologies of the

languages in contact (unambiguous phonemic cognates). When structural correspondences were opaque from a surface phonological perspective (ambiguous phonemic cognates), on the other hand, phonetic transfer was less likely and when it did occur, it was a result of the under-differentiation process whereby L2 sounds are equated with perceptually similar L1 sounds (with which no structural relation exists).

The phonetic detail and transfer findings described in this chapter have, of course, implications for the dialect contact study, presented in Chapter 5. The findings of the language contact study will thus be discussed, with specific reference to the residue hypothesis in the ‘Discussion and Conclusions’ section of the thesis, in light of the dialect contact results.

CHAPTER 5

THE DIALECT CONTACT STUDY

« Le meilleur des mondes sera-t-il celui de la discipline et de la parfaite monotonie ? Puissent survivre encore longtemps tous ces régionalismes du français, ces heureuses, ces savoureuses désobéissances. »

(Gaston Tuaillon, *Le français régional*, 1988)

This chapter presents the results of the dialect contact study and, therefore, examines the evidence for phonological and phonetic change in the French mid- and nasal vowels across three generations of French speakers. We have seen that some characteristics of the mid- and nasal vowels in the French of the older generation can be ascribed to language contact with Béarnais leading to phonetic transfer, whereas in other cases new phonetic categories have emerged for these L2 speakers. In this chapter, I use an apparent-time contrast of these speakers with two younger generations to investigate subsequent changes in the phonological categories and quality of the same vowels. These changes, potentially ascribable to dialect contact with other (primarily northern) varieties of French, are interpreted with reference to Kerswill's (2003) model of Regional Dialect Levelling (RDL). This has the aim of explaining why some features which we may consider to be 'substrate residue' are retained by younger generations while others are lost from RF.

5.1 FRENCH MID-VOWELS

For each generation, the analysis focuses on both phonological and phonetic variation: evidence for the maintenance of phonemic contrast; evidence for use of the *loi de position*; relative position of the mid-vowels in the acoustic vowel space. Analysing these parameters has the aim of examining convergence towards and divergence from the standard, supralocal and majority southern norms. Since the findings for the oldest generation are presented in detail in Chapter 4, a brief summary will suffice here for the purposes of comparison. The synchronic findings for the three generations are compared qualitatively in Section 5.1.4 to examine the changing nature of the mid-vowel systems. Finally, the phonetic evolution of the mid-vowels is examined statistically.

5.1.1 OLDER GENERATION

All old speakers were shown to distinguish significantly between the front mid-vowel phonemes (/e/ and /ɛ/) on the basis of F1, but not F2: both male and female speakers thus make the traditional SF vowel height distinction between the vowels but the vowels are not distinguished in terms of frontness/backness. By contrast, /o/ and /ɔ/ were not distinguished on the basis of F1 or F2, indicating that the historical phonemic height distinction between the back vowels was not present in their variety of French.

The *loi de position* was shown to be used significantly in the speech of the old speakers: open variants occurred in closed syllables and close variants in open syllables. For both mid-vowel pairs, syllable type was also shown to have a highly significant effect on the value of F2. Thus, a ‘modified’ *loi de position* was found to

be active: for the front mid-vowels, close front vowels occurred in open syllables and open centralised vowels in closed syllables; for the back mid-vowels, close centralised variants in medial open syllables, close back variants in final open syllables and open back variants in closed syllables.

5.1.2 MIDDLE GENERATION

Token counts for the mid-vowels produced by the middle generation are presented in Table 5.1 for female (K-O) and male (P-T) speakers: the tokens are distributed relatively evenly across speakers and across vowels, with the exception of /ɔ/, which was less frequent over all. For the F1-F2 plots that follow, the reference vowels (/i/ /a/ /u/) are plotted using F1 and F2 values from approximately 15 tokens per speaker.

Sex	Speaker	/e/	/ɛ/	/o/	/ɔ/
F	K	22	21	22	17
	L	22	25	26	13
	M	23	24	22	22
	N	23	21	25	18
	O	18	24	21	24
M	P	24	22	25	19
	Q	23	24	27	16
	R	26	19	23	22
	S	21	24	26	20
	T	24	21	31	15
Total		226	225	248	186

Table 5.1. Token counts for French mid-vowels by ‘Middle’ speakers (F = female; M = male).

Figure 5.1 presents the raw F1 and F2 values for tokens of the mid- and reference vowels for middle male speakers and Figure 5.2 the corresponding means and

standard deviations³⁸. The general position of the vowels relative to each other conforms to the schematised vowel space for French (see Figure 4.19). Varying degrees of overlap, between the mid-vowels and the close reference vowels, are evident for all speakers, except Speaker R, although there is no overlap with /a/.

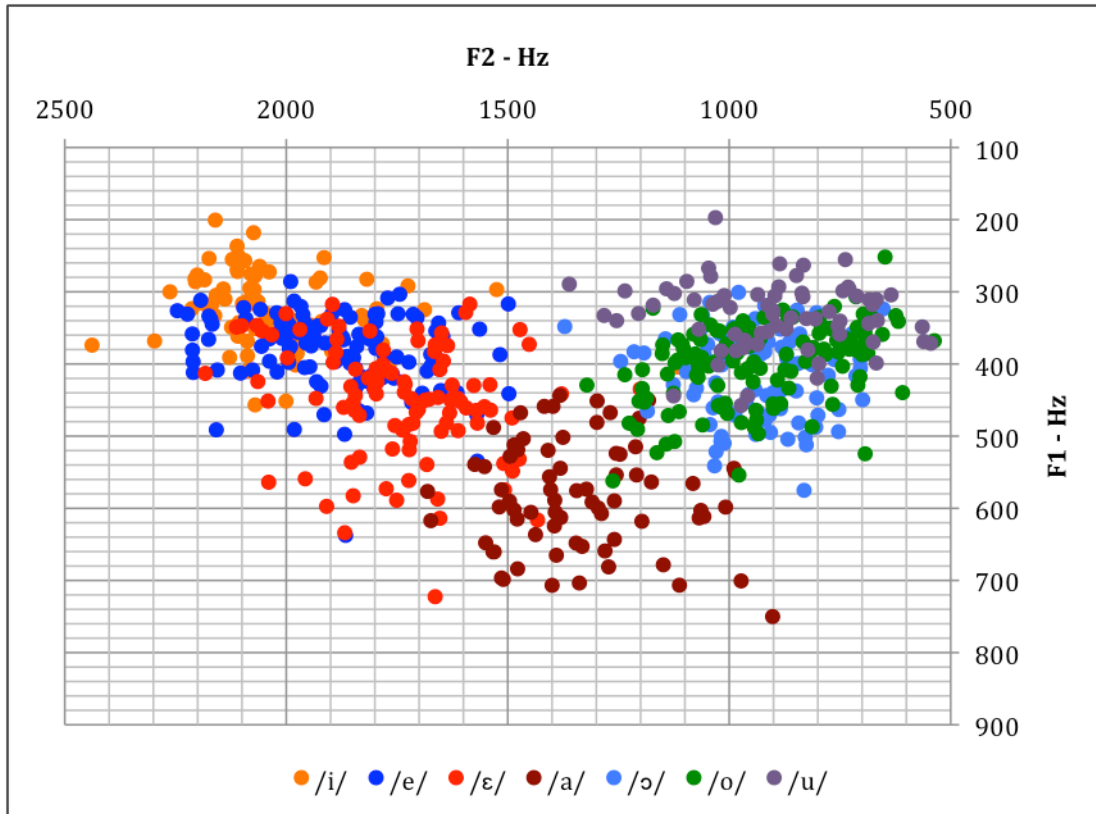


Figure 5.1. Middle Male speakers: F1 and F2 values for French mid-vowels with reference vowels.

³⁸ For all figures in this chapter presenting data as means and standard deviations, the numerical values have been tabulated and may be consulted in Appendix 5A.

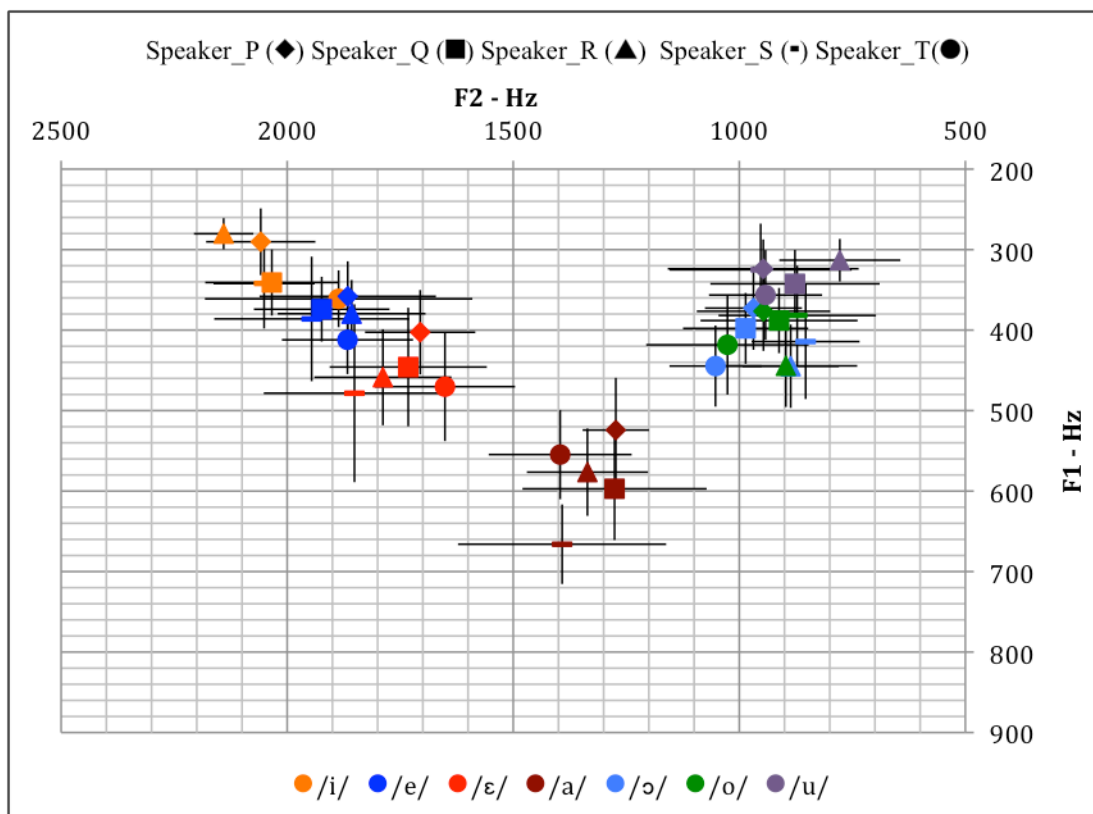


Figure 5.2. Middle Male speakers: Mean F1 and F2 values and standard deviations for French mid-vowels with reference vowels.

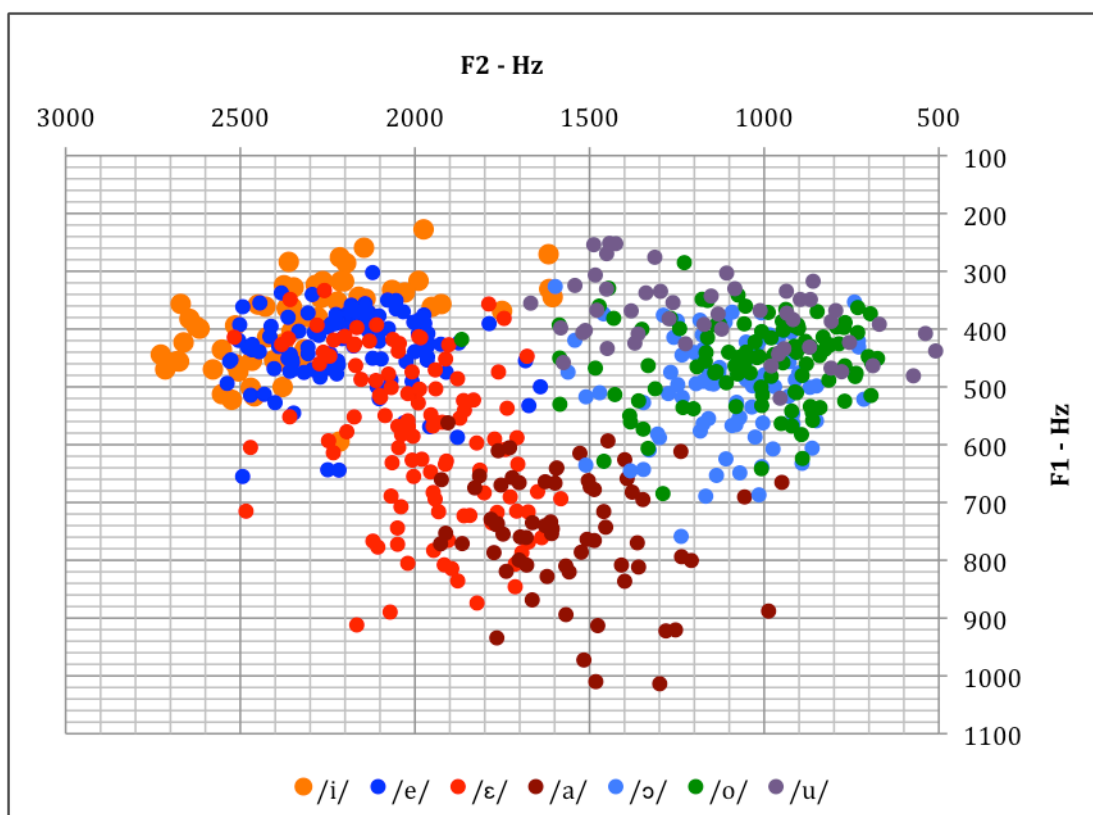


Figure 5.3. Middle Female speakers: F1 and F2 values for French mid-vowels with reference vowels.

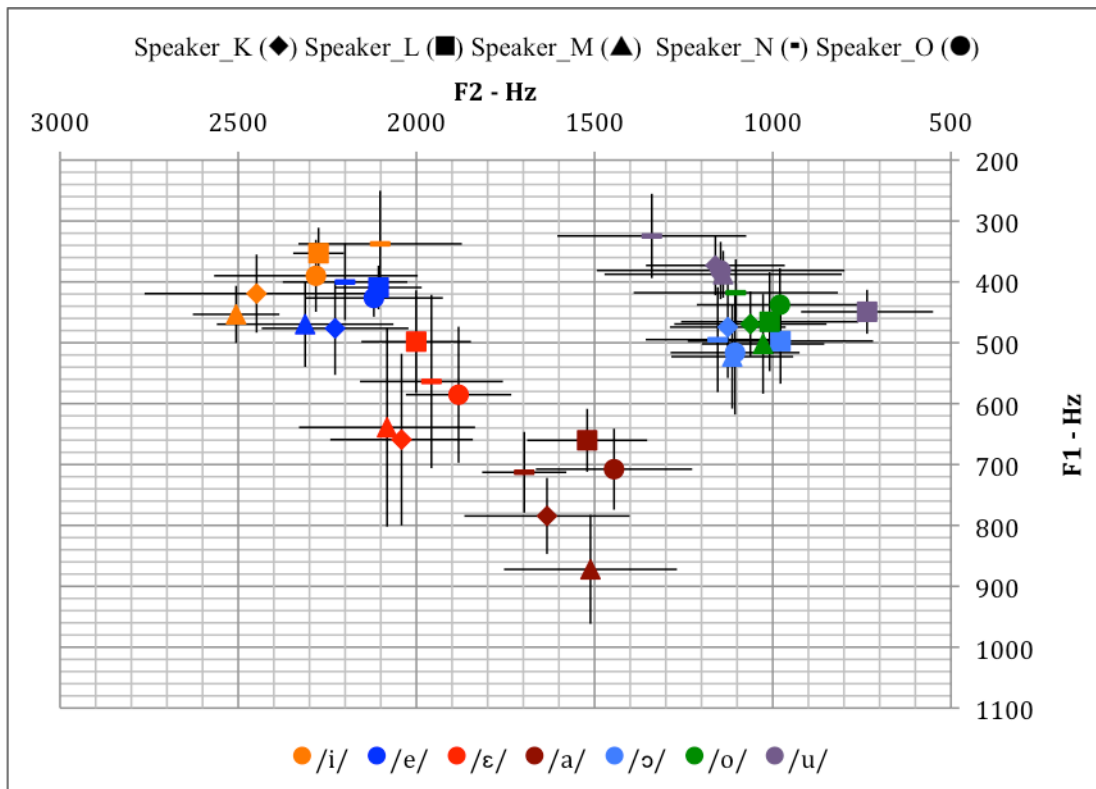


Figure 5.4. Middle Female speakers: Mean F1 and F2 values and standard deviations for French mid-vowels with reference vowels.

Figure 5.3 and 5.4 presents the corresponding F1 and F2 values for the mid and reference vowels produced by female speakers. Overlap between the three reference vowels and the mid-vowel pairs is evident when all speakers are considered together. Again, the distribution of /a/ is separate from the adjacent mid-vowels for all speakers, but varying degrees of overlap are evident with the close reference vowels (with the exception of /i/ for Speaker L and /u/ for Speaker M). The following sections examine the distribution of the mid-vowels more closely.

5.1.2.1 FRONT MID-VOWELS

The raw F1 and F2 data for male speakers presented in Figure 5.1. shows overlap between /e/ and /ε/ on both dimensions. For all middle male speakers, the mean values of F1 are higher for /ε/ than /e/, and the mean values for F2 are lower for

/ɛ/, showing that /ɛ/ is lower and more centralised than /e/ (Figure 5.2). The standard deviations nevertheless reveal overlap between the distributions of /e/ and /ɛ/ for both F1 and F2 for all speakers, showing that neither dimension is used consistently to distinguish between the vowels, although Speaker Q does have a high degree of F1 separation between /e/ and /ɛ/.

The F1 and F2 tokens for female speakers presented in Figure 5.3 show that, as for male speakers, there is a high level of overlap between the distributions of /e/ and /ɛ/ when all speakers are considered together but with clustering of /e/ within a lower F1 range. The distribution of /ɛ/ also appears to be more centralised than that of /e/. For the mean values (and standard deviations) presented in Figure 5.4, all speakers show the expected F2 overlap between the mid-vowels but with a tendency for the mean value of /ɛ/ to be more centralised than that of /e/. Speaker O is the only female speaker to produce /e/ and /ɛ/ as phonetically distinct on the (traditional) F1 dimension, with very little variation for /e/ on this dimension. Speakers K and L exhibit less F1 overlap for the front mid-vowels than Speakers M and N.

Overall, neither male nor female speakers produce the front mid-vowels as clearly phonetically distinct in terms of vowel height. There is, however, a tendency across speakers to realise /ɛ/ as lower and more centralised than /e/ but standard deviations suggest that this distinction is not consistently maintained.

5.1.2.1.1 MODELLING THE FRONT MID-VOWELS

The statistical analysis uses mixed-effects linear regression models with ‘speaker’ and ‘word’ as random effects and the same fixed effect factor groups as those detailed for older speakers, (see Table 4.58).

Table 5.2 presents the results of the F1 regression model using normalised data from male and female speakers. Two significant effects are included as predictors of F1 values: syllable type ($p \leq 0.01$) and F2 ($p \leq 0.05$). Phoneme, speaker sex and lexical frequency were returned as non-significant. The non-significant finding for ‘phoneme’ suggests that speakers do not make the a significant phonetic distinction between /e/ and /ɛ/ on the basis of F1. We may note, however, that when ‘phoneme’ is included as the only fixed effect in a mixed model, it is returned as highly significant ($p = 1.99e-20$). In the model presented in Table 5.2, on the other hand, ‘syllable type’ explained more variation within the data set than ‘phoneme’: the varying levels of separation between /e/ and /ɛ/ in the raw data and individual means (Figures 5.1-5.4) are shown to be more robustly linked to phonological context than to the historical phonemic identity of the vowel. This highly significant effect of syllable type on F1 shows that the *loi de position* is used in the front mid-vowels for the middle generation: final closed syllables favour high F1 values (open vowels) while final open and medial open syllables favour low F1 values (close vowels). This finding implies that the *loi de position* is stronger than, and thus neutralises, the phonemic distinction between the front mid-vowels. The magnitude of this effect is relatively large. Finally, there is a significant negative correlation between F1 and F2: as the value of F2 increases (and the vowel is more front), the value of F1 decreases (and the vowel is more close). This correlation is included at the lower significance threshold ($p \leq 0.05$) and the magnitude of the regression

coefficient is relatively low. It reflects the tendency in the raw data, for both male and female speakers for /e/ to be closer and fronter than /ɛ/, but it holds regardless of the phonemic identity of the mid-vowels: the more open a front mid-vowel (both /e/ and /ɛ/), the more centralised it will also be.

Dependent variable = F1 N = 451 Grand mean = 0.04		Deviance: 730 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Syllable Type	/CvC#/	0.816	149	6.33e-22
	/Cv#/	-0.381	158	
	/vCV(C)#/	-0.434	144	
F2	Continuous variable	-0.091	451	0.0196
Non-significant factor groups were Phoneme (p=0.491), Speaker sex (p=0.841), and Lexical frequency (p=0.951).				

Table 5.2. Middle Generation: Results of mixed-effects linear regression for F1 (/E/).

The regression model for F2 is presented in Table 5.3. No fixed-effect factor groups are returned as significant predictors of the variation. This means, among other things, that the middle generation do not make a significant distinction between the phonemes /e/ and /ɛ/ on the basis of F2 and do not exhibit significant allophonic variation conditioned by syllable type in the front mid-vowels. The negative correlation between F1 and F2, returned in the F1 model above, is not included as significant in the F2 model. Therefore, it is not clear if the F1/F2 correlation reported above is entirely meaningful.

Dependent variable = F2 N = 451 Grand mean = 0.777	Deviance: 570 Degrees of freedom: 10
Non-significant factor groups were Phoneme (p=0.0623), Speaker sex (p=0.0719), F1 (p=0.0998), Syllable type (p=0.196), and Lexical frequency (p=0.341).	

Table 5.3. Middle Generation: Results of mixed-effects linear regression for F2 (/E/).

While vowel length is not explicitly the focus of this analysis, a mixed-effects regression analysis (including ‘phoneme’ as a fixed effect factor group) revealed that there is a significant difference between /e/ and /ɛ/ ($p=0.00432$): vowel length is used contrastively for the front mid-vowels in the middle generation where /e/ is significantly longer than /ɛ/. The magnitude of this effect is very small (± 0.013) but consistently so.

5.1.2.2 BACK MID-VOWELS

The individual /o/ and /ɔ/ tokens are plotted for male speakers in Table 5.1 and the mean F1 and F2 values and standard deviations for each individual are presented in Figure 5.2. All speakers exhibit a high level of overlap between the vowels. For Speakers P and R, the mean F1 and F2 values for the two vowels are strikingly similar as are their standard deviations. For Speakers S and T, the mean F1 value is slightly higher for /ɔ/ than for /o/ while for Speaker Q, the mean F2 value of /ɔ/ is higher than that of /o/ (/ɔ/ is more centralised). In any case, the high degree overlap between the standard deviations of the back vowels for all speakers suggests that none of them consistently distinguishes phonetically between the vowels on the basis of F1 or F2.

Individual back mid-vowel tokens are plotted for female speakers in Figure 5.3 and Figure 5.4 provides the individual mean F1 and F2 values and standard deviations. All female speakers exhibit a high degree of overlap between the vowels with varying degrees of separation between the mean F1 and F2 values. With the exception of Speaker L, mean F2 values for /ɔ/ are higher than the mean values for

/o/: the /ɔ/ vowel is more centralised. Additionally, the mean F1 value for /ɔ/ is higher for all speakers: the /ɔ/ vowel is lower. However, the standard deviations indicate that neither of these tendencies is consistent in distinguishing between the back mid-vowels.

5.1.2.2.1 MODELLING THE BACK MID-VOWELS

The regression model for F1, including male and female speakers, is provided in Table 5.4. Three predictors are returned as highly significant: syllable type ($p \leq 0.01$); F2 ($p \leq 0.01$); phoneme ($p \leq 0.01$). Lexical frequency and speaker sex were returned as non-significant. The highly significant effect for syllable type confirms that the *loi de position* is used by all speakers for the back mid-vowels: final closed syllables favour high F1 values (open vowels) and final and medial open syllables favour low F1 values (close vowels). We can note, on the basis of the regression coefficients, that medial open syllables favour closer vowels than final open syllables. There is a significant positive correlation between F1 and F2: as the value of F2 increases (and the vowel is more centralised), the value of F1 also increases (and the vowel more open). This correlation between lowering and centralisation was also seen for the front mid-vowels. Finally, the highly significant effect for phoneme shows /ɔ/ to favour high F1 values while /o/ favours low F1 values. This means that the traditional SF vowel height distinction between the back mid-vowels is implemented phonetically by the middle generation of speakers: /o/ is significantly closer than /ɔ/.

For the raw data and individual means presented in Figures 5.1-5.4, there appears to be far more overlap between the back mid-vowels than between the front

mid-vowels (particularly for F1). In the statistical analyses, on the other hand, ‘phoneme’ is returned as non-significant for /e/ and /ɛ/, but not for /o/ and /ɔ/. As noted in Section 5.1.2.1.1 above, ‘phoneme’ has not been included in the model for the front mid-vowels because ‘syllable type’ was returned as a more robust predictor of the vowel height variation observed.

Dependent variable = F1 N = 434 Grand mean = -0.072		Deviance: 703 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C v C#/	0.454	143	3.62e-16
	/C v #/	-0.092	145	
	/v C V(C)#/	-0.363	146	
F2	Continuous variable	0.224	434	1.8e-05
Phoneme	/ɔ/	0.151	186	0.000863
	/o/	-0.151	248	
Non-significant factor groups were Lexical frequency (p=0.0596) and Speaker sex (p=0.28)				

Table 5.4. Middle Generation: Results of mixed-effects linear regression for F1 (/O/).

The regression model for F2 is presented in Table 5.5. F1 is returned as the only significant predictor of the variation observed. As we saw for the regression model in Table 5.4 above, there is a significant positive correlation between F1 and F2: more open back vowels are also significantly centralised. Since we have seen that /ɔ/ is significantly lower than /o/, it follows from this that /ɔ/ is also centralised relative to /o/ given the significant correlation between F1 and F2 returned by both models. Although F2 is higher for open vowels, this tendency is not strong enough to

distinguish between the back vowels phonemically. It is clearly F1 (vowel height) that carries the phonemic distinction and not F2.

Dependent variable = F2 N = 434 Grand mean = -0.918		Deviance: 614 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.189	434	9.85e-06
Non-significant factor groups were Syllable type (p=0.0777), Phoneme (p=0.134), Speaker sex (p=0.825), and Lexical frequency (p=0.826).				

Table 5.5. Middle Generation: Results of mixed-effects linear regression for F2 (/O/).

As for the front mid-vowels, a regression analysis was undertaken for vowel duration in the back mid-vowels. The results of this analysis show that vowel length is not used contrastively to distinguish between /o/ and /ɔ/ (p=0.549) by middle speakers.

5.1.2.3 SUMMARY OF THE MID-VOWELS FOR THE MIDDLE GENERATION

Speakers in the middle generation make no distinction between the front mid-vowels, /e/ and /ɛ/ (when both ‘syllable type’ and ‘phoneme’ are included in the mixed-effects model). For the back mid-vowels, /o/ and /ɔ/, speakers make a significant vowel height distinction between them with /o/ positioned significantly closer in the vowel space than /ɔ/. In both the front and back of the vowel space, the mid-vowels exhibit contextually conditioned allophones on the F1 dimension which follow the *loi de position*: more open variants occur in closed syllables; closer variants occur in open syllables. In the case of the front-vowels, the non-significant phonetic distinction between the historical phonemes as well as the significant *loi de position*

effect confirms that phonemic contrasts in open final syllables are not maintained, e.g. ‘j’irai’ /ʒiʁe/ ~ ‘j’irais’ /ʒiʁɛ/.

5.1.3 YOUNG GENERATION

Token counts of the mid-vowels are presented in Table 5.6 for young generation female (U-Y) and male (Z, @, \$, £, €) speakers: tokens are relatively evenly distributed across speakers and across vowels, with reduced numbers again evident for /ɔ/. The reference vowel data set included approximately 15 tokens of each vowel (/i/, /a/, /u/) per speaker.

Sex	Speaker	/e/	/ɛ/	/o/	/ɔ/
F	U	22	22	27	17
	V	20	23	27	20
	W	23	23	30	16
	X	19	23	24	24
	Y	19	22	29	18
M	Z	22	24	28	18
	@	20	25	27	17
	\$	23	21	21	14
	£	20	26	26	14
	€	20	21	24	21
Total		208	230	263	179

Table 5.6. Token counts for French mid-vowels by ‘Young’ speakers (F = female; M = male).

F1 and F2 values for tokens of the mid-vowels are presented in Figure 5.5 for young male speakers. All reference vowels exhibit distributions that overlap with those of their adjacent mid-vowels when all male speakers are considered together. The position of the vowels relative to each other conforms to the schematised vowel space presented for French (see Figure 4.19). Figure 5.6 presents the mean F1 and F2

values and standard deviations for the mid- and reference vowels for individual male speakers. With the exception of Speaker €, all speakers have an /i/ distribution which overlaps with that of /e/ (and also /ε/, for Speaker @). The distribution of /a/ is separate from the adjacent mid-vowels for all speakers. For Speakers \$, £ and €, the distribution of /a/ overlaps somewhat with /ε/ on the F1 dimension but they are completely separate on the F2 dimension. Finally, /u/ overlaps somewhat with /o/ and /ɔ/ for all speakers (with the exception of Speaker Z for whom overlap is only evident between /u/ and /o/).

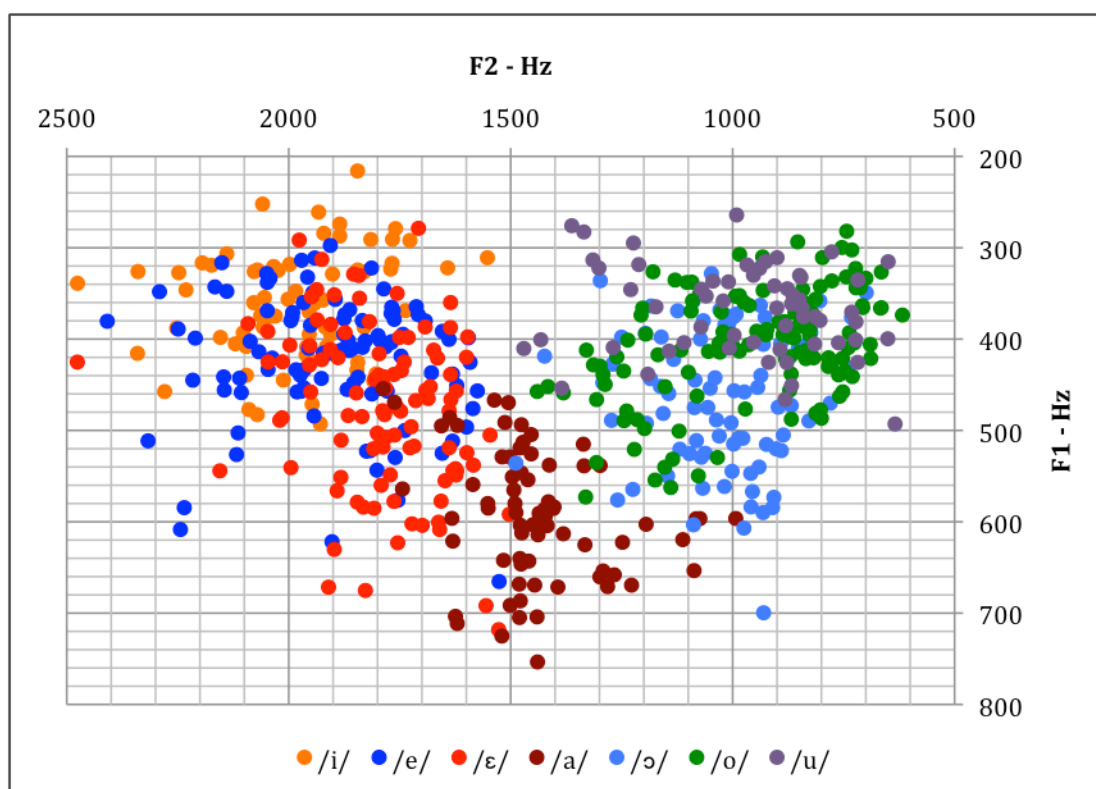


Figure 5.5. Young Male speakers: F1 and F2 values for French mid-vowels with reference vowels.

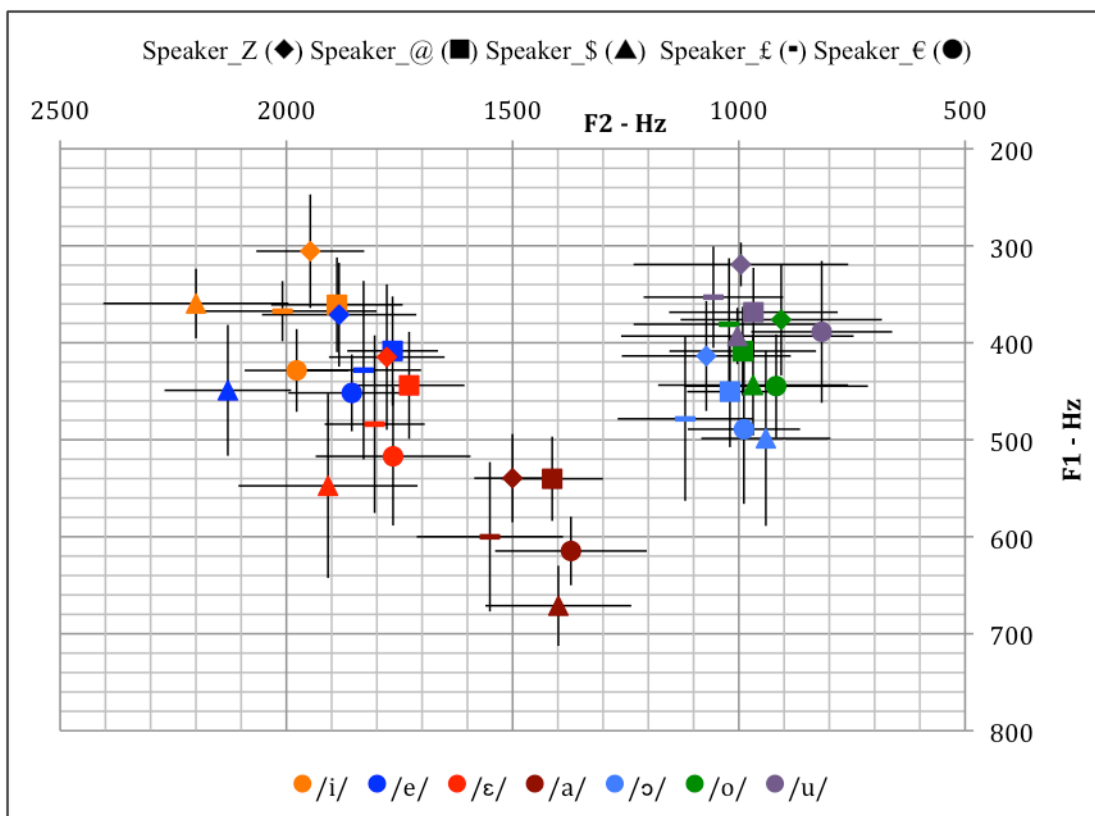


Figure 5.6. Young Male speakers: Mean F1 and F2 values and standard deviations for French mid-vowels with reference vowels.

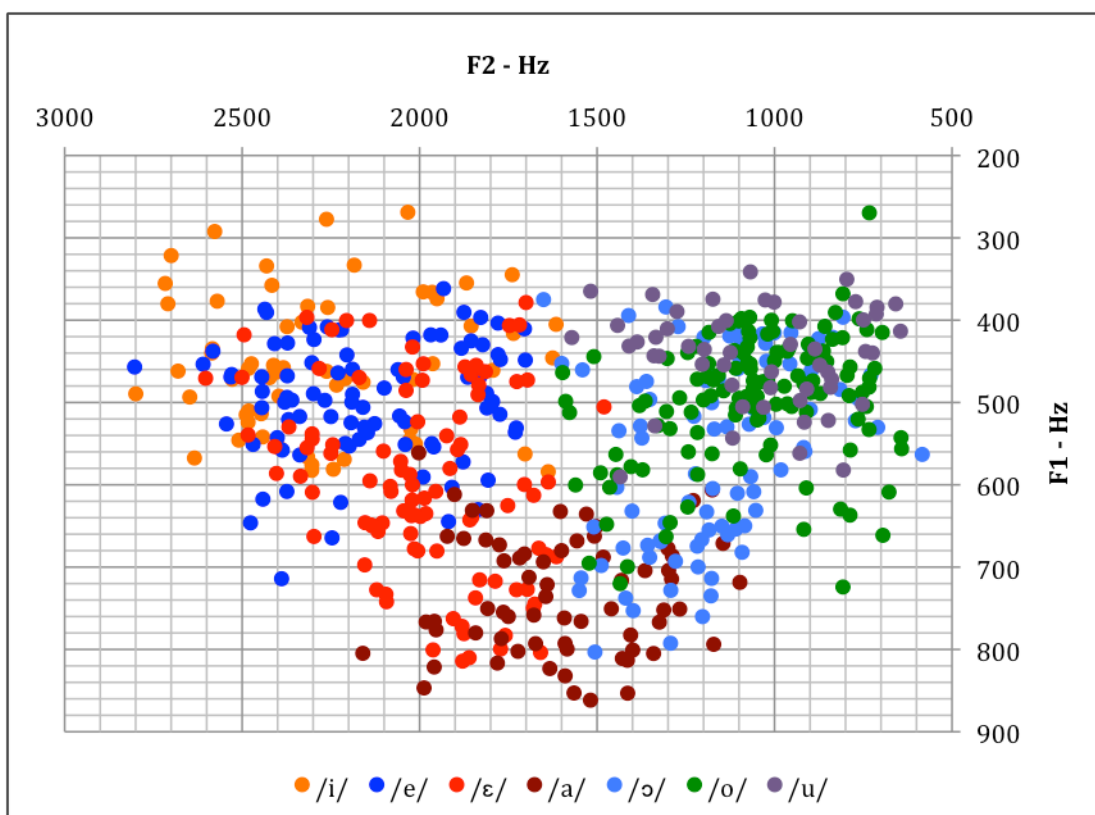


Figure 5.7. Young Female speakers: F1 and F2 values for French mid-vowels with reference vowels.

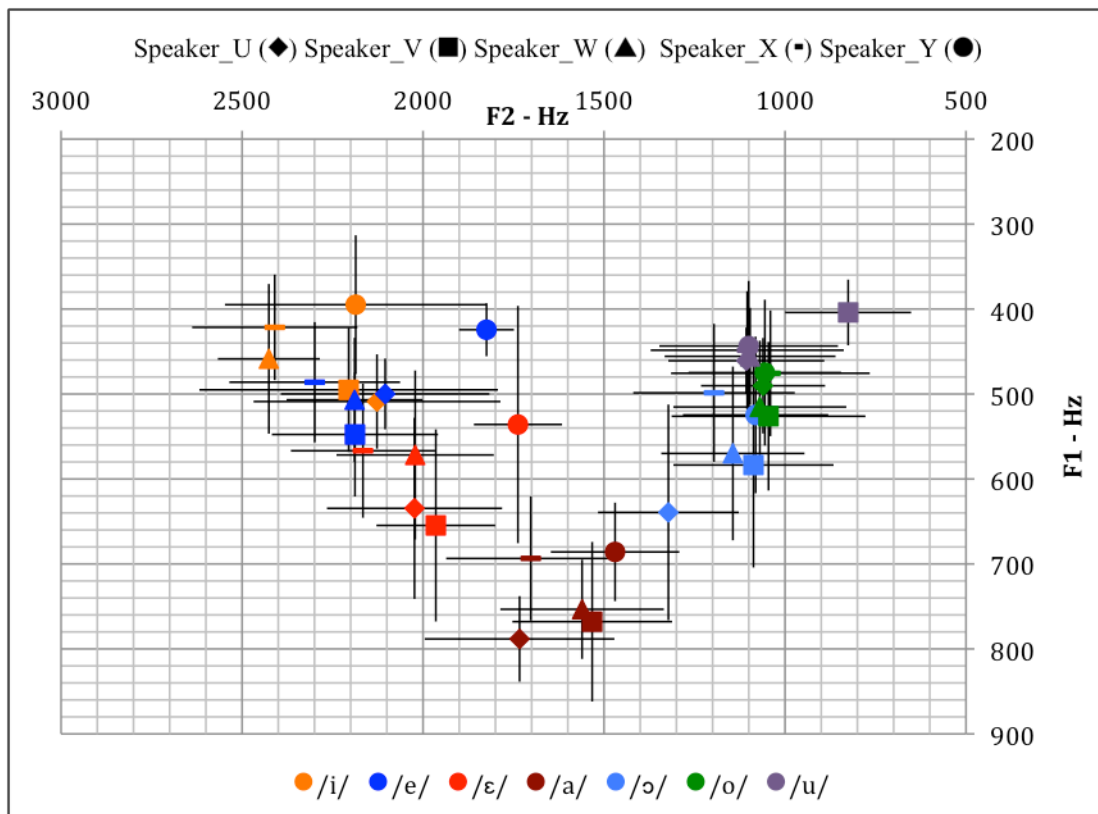


Figure 5.8. Young Female speakers: Mean F1 and F2 values and standard deviations for French mid-vowels with reference vowels.

Figure 5.7 presents the F1 and F2 values for tokens of the mid- and reference vowels produced by female speakers. Once again, overlap is evident between the reference vowels and their adjacent mid-vowels when all female speakers are considered together. The mean F1 and F2 values and standard deviations for the mid- and reference vowels are provided in Figure 5.8. The distribution of /i/ overlaps somewhat with that of /e/ for all speakers (and also with that of /ε/ for Speakers U, V and Y). The distribution of /a/ exhibits overlap with that of /ε/ for Speakers U and Y. There is some F1 overlap between /a/ and /ε/ for the other speakers but the standard deviations are completely separate on the F2 dimension. Finally, varying degrees of overlap are evident between /u/ and /o/ and /ɔ/ for all speakers (except Speaker V for whom /u/ is completely separate).

5.1.3.1 FRONT MID-VOWELS

The F1 and F2 values for the front mid-vowel tokens are presented for young male speakers in Figure 5.5. When all male speakers are considered together, there is a high level of overlap evident on the F1 and F2 dimensions, with a tendency for /e/ to be fronter than /ɛ/. Figure 5.6 presents the means and standard deviations for individual male speakers. All male speakers exhibit both F1 and F2 overlap between the distributions of /e/ and /ɛ/ and all mean values for /ɛ/ are lower and more centralised than those of /e/ for individual speakers. Speaker £, however, shows less F2 separation between the mean values of the front mid-vowels than other speakers. Speaker \$, on the other hand, exhibits the most separation between /e/ and /ɛ/ on the basis of vowel height and vowel frontness/backness.

Figure 5.7 presents the F1 and F2 values for tokens of the front mid-vowels produced by young female speakers. There is a tendency for /e/ to be higher in the vowel space than /ɛ/ but, as for the young male speakers, there is a substantial degree of overlap between their distributions when all speakers are considered together. The mean F1 and F2 values and standard deviations for the front mid-vowels are presented, for younger female speakers, in Figure 5.8. With the exception of Speaker U, female speakers exhibit the same pattern as male speakers: mean values for /ɛ/ are low and centralised relative to /e/; the distributions of /e/ and /ɛ/ overlap on the F1 and F2 dimensions. Speaker U also reflects this pattern but exhibits separation between the vowels on the F1 dimension, therefore using the SF vowel height distinction.

5.1.3.1.1 MODELLING THE FRONT MID-VOWELS

The results of the mixed-effects regression model for F1 are presented in Table 5.7. Syllable type is the only significant predictor of F1 values ($p \leq 0.01$). Lexical frequency, F2, phoneme and speaker sex are all returned by the analysis as non-significant. Thus, young speakers do not consistently differentiate between the traditional SF phonemes, /e/ and /ɛ/, on the basis of F1. The highly significant effect for syllable type reveals allophonic variation in the front mid-vowels which conforms to the *loi de position*: open vowels in closed syllables; close vowels in open syllables. The magnitude of this effect is substantial.

Dependent variable = F1 N = 438 Grand mean = 0.061		Deviance: 727 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C v C#/	0.901	142	1.72e-21
	/C v #/	-0.439	151	
	/ v CV(C)#/	-0.462	145	
Non-significant factor groups were Lexical frequency (p=0.103), F2 (p=0.213), Phoneme (p=0.316), and Speaker sex (p=0.714).				

Table 5.7. Young Generation: Results of mixed-effects linear regression for F1 (/E/).

Table 5.8 presents the results of the regression model for F2 in the front mid-vowels. Two fixed effect factor groups are returned as significant predictors: syllable type ($p \leq 0.01$) and phoneme ($p \leq 0.05$). Lexical frequency, speaker sex and F1 were all returned as non-significant. The highly significant effect for syllable type reveals the following allophonic variation in F2: final open syllables favour fronter vowels; final closed syllables and medial open syllables favour centralised vowels. The magnitude of this effect is small when compared with the syllabic conditioning for F1. Combining the F1 and F2 analyses, however, we can see the following patterns: final open syllables favour close front vowels; medial open syllables favour close

centralised vowels; final closed syllables favour open centralised vowels. The significant result for ‘phoneme’ shows that young speakers make a phonetic distinction between the traditional front mid-vowel phonemes on the basis of F2: /e/ favours high F2 values while /ɛ/ favours lower F2 values. This means that /e/ is realised as significantly fronter than /ɛ/. The raw data and means presented in Figures 5.5-5.8 suggest that this F2 distinction is greater for female speakers than for males but this is not returned as significant by the regression analysis. The traditional SF distinction between the front mid-vowels is one of vowel height and not vowel frontness but younger speakers seem to exploit variation on the F2 dimension to distinguish between the phonemes.

Dependent variable = F2 N = 438 Grand mean = 0.755		Deviance: 655 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C v #/	0.182	151	9.99e-05
	/v C V(C)#/	-0.089	145	
	/C v C#/	-0.093	142	
Phoneme	/e/	0.121	208	0.0106
	/ɛ/	-0.121	230	
Non-significant factor groups were Lexical frequency (p=0.109), Speaker sex (p=0.42) and F1 (p=0.727).				

Table 5.8. Young Generation: Results of mixed-effects linear regression for F2 (/E/).

A regression analysis of vowel duration showed that speakers in the young generation do not distinguish significantly between the front mid-vowels on the basis of vowel length (p=0.867).

5.1.3.2 BACK MID-VOWELS

Individual tokens produced by male speakers are presented in Figure 5.5. A high degree of overlap is evident between the back mid-vowels when all male speakers are considered together. Figure 5.6 presents the mean F1 and F2 values and standard deviations for the back mid-vowels produced by individual male speakers. All male speakers exhibit overlapping distributions, in F1 and F2. For all speakers, the mean value for /ɔ/ is lower and more centralised than the corresponding /o/ value, with the exception of Speaker \$ for whom /ɔ/ is backed.

Individual back mid-vowel tokens are plotted for young female speakers in Figure 5.7, and Figure 5.8 presents the F1 and F2 means and standard deviations for individual female speakers. Overall, the relative position of the back mid-vowels for female speakers is similar to that of male speakers, with a high degree of overlap for both F1 and F2. Mean values for /ɔ/ are also low and centralised relative to /o/ for female speakers, although centralisation is minimal for Speaker V. Speaker U produces the highest degree of separation on both dimensions, with particularly marked centralisation.

5.1.3.2.1 MODELLING THE BACK MID-VOWELS

The mixed-effects regression model for F1 is provided in Table 5.9. Three significant predictors are included in the model: syllable type ($p \leq 0.01$); F2 ($p \leq 0.01$); phoneme ($p \leq 0.05$). Lexical frequency and speaker sex were returned as non-significant. The highly significant effect for syllable type reveals allophonic variation in F1 that conforms to the *loi de position*: closed syllables favour high F1 values (open vowels); open syllables favour low F1 values (close vowels). The magnitude of the difference between the regression coefficients for this effect are also relatively large.

There is also a highly significant positive correlation between F1 and F2: centralised vowels are also lower in the vowel space. This confirms the observations made for male and female speakers in the raw data. Finally, phoneme is returned as a significant predictor: /o/ favours low F1 values and /ɔ/ favours high F1 values. This shows that young speakers make a vowel height distinction between the back mid-vowels: /o/ is significantly closer than /ɔ/. The significant results for both syllable type and phoneme are contradictory in that the use of the *loi de position* implies the neutralisation of phonemic contrast. In a simpler regression model including only syllable type and phoneme as fixed effect factor groups (as well as ‘speaker’ and ‘word’ as random effects), syllable type is returned as the only significant predictor ($p = 2.91\text{e-}21$) suggesting that younger speakers do not make a significant distinction between the back mid-vowels on the basis of F1.

Dependent variable = F1 N = 442 Grand mean = -0.117		Deviance: 740 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C v C#/	0.544	149	1.18e-16
	/C v #/	-0.109	153	
	/ v CV(C)#/	-0.113	140	
F2	Continuous variable	0.414	442	6.99e-13
Phoneme	/ɔ/	0.113	179	0.0343
	/o/	-0.113	263	
Non-significant factor groups were Lexical frequency (0.146) and Speaker sex (0.746).				

Table 5.9. Young Generation: Results of mixed-effects linear regression for F1 (/O/).

Figure 5.10 presents the regression model for F2. Four significant predictors are included in the model: F1 ($p \leq 0.01$); syllable type ($p \leq 0.01$); speaker sex ($p \leq 0.05$); phoneme ($p \leq 0.05$). The positive correlation between F1 and F2 is again returned as

highly significant: low vowels are also significantly centralised. Syllable type can be seen to condition allophonic variation in F2: medial open syllables and final closed syllables favour centralised vowels; final open syllables favour back vowels. Considering the syllable effect for allophonic variation in F1 and F2 together, the following pattern is revealed: final closed syllables favour open centralised vowels; final open syllables favour close back vowels; medial open syllables favour close centralised vowels. The significant effect for ‘phoneme’ reveals young speakers to distinguish consistently between /o/ and /ɔ/ on the basis of F2: /o/ favours high F2 values while /ɔ/ favours lower F2 values. This implies that /o/ is centralised relative to /ɔ/ which belies the observations made in the raw data (where mean /ɔ/ values were higher on the F2 dimension than those of /o/). The magnitude of this effect is extremely small and the probability is also low. A simpler regression model including only syllable type and phoneme as fixed effects returned only syllable type as a significant predictor ($p=1.32e-07$). This suggests that the variation in F2 observed in the back mid-vowels is allophonic rather than phonemic, as was the case for F1 above. There is also a significant effect for speaker sex which can be explored in more depth by examining the regression models run for young male and female speakers separately.

Dependent variable = F2 N = 442 Grand mean = -0.878		Deviance: 560 Degrees of freedom: 10		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.258	442	2.11e-11
Syllable type	/vCV(C)#/	0.140	140	0.000257
	/CvC#/	0.095	149	
	/Cv#/	-0.236	153	
Speaker sex	Female	0.063	232	0.0358
	Male	-0.063	210	
Phoneme	/o/	0.078	263	0.0439
	/ɔ/	-0.078	179	
Non-significant factor groups were Lexical frequency (0.91).				

Table 5.10. Young Generation: Results of mixed-effects linear regression for F2 (/O/).

Table 5.11 presents the regression model for male speakers in which syllable type ($p \leq 0.01$), F1 ($p \leq 0.01$) and phoneme ($p \leq 0.05$) are returned as significant predictors. Male speakers show similar effects to those presented in Table 5.10 when all speakers were considered together.

Dependent variable = F2 N = 210 Grand mean = -0.942		Deviance: 224 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/vCV(C)#/	0.155	62	0.000226
	/CvC#/	0.145	74	
	/Cv#/	-0.301	74	
F1	Continuous variable	0.197	210	0.000241
Phoneme	/o/	0.098	126	0.042
	/ɔ/	-0.098	84	
Non-significant factor groups were Lexical frequency (0.53)				

Table 5.11. Young Male speakers: Results of mixed-effects linear regression for F2 (/O/).

As was the case for the composite F2 model, a simpler model for the male speakers' back mid-vowels including only syllable type and phoneme as fixed effects returned syllable type as the only significant predictor ($p=1.45e-06$) again suggesting that the variation observed is allophonic rather than phonemic.

The regression model for female speakers, presented in Table 5.12, reveals phoneme to be non-significant ($p=0.146$). This shows that while male speakers distinguish between /o/ and /ɔ/ phonetically on the basis of F2, female speakers do not. The effects for F1 and syllable type mirror those described in the composite model above (Table 5.10).

Dependent variable = F2 N = 232 Grand mean = -0.82		Deviance: 331 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.301	232	4.87 ^e -08
Syllable type	/vCV(C)#/	0.132	78	0.0162
	/CvC#/	0.084	75	
	/Cv#/	-0.216	79	
Non-significant factor groups were Phoneme (0.146) and Lexical frequency (0.799)				

Table 5.12. Young Female speakers: Results of mixed-effects linear regression for F2 (/O/).

A regression analysis of vowel duration showed that speakers in the young generation do not distinguish significantly between the back mid-vowels on the basis of vowel length ($p=0.589$).

5.1.3.3 SUMMARY OF THE MID-VOWELS FOR THE YOUNG GENERATION

Speakers in the young generation make a significant phonetic distinction between the front mid-vowels on the basis of F2 alone (/ɛ/ is centralised relative to /e/). For the

back mid-vowels, there was evidence to suggest that young speakers distinguish phonetically between the /o/ and /ɔ/ on the basis of F1 (/o/ is closer in the vowel space than /ɔ/) but additional models comparing only syllable type and phoneme as fixed effects showed syllable type to be the most significant predictor of the variation observed thus neutralising the phonemic distinction between the back mid-vowels on the basis of F1. There was also evidence to suggest that speakers use F2 to distinguish between the back mid-vowels but this was determined not to be true for female speakers and to be a low magnitude effect for male speakers. Both front and back mid-vowels were shown to have allophonic variants for F1 that conformed to the *loi de position*. When the phonemic distinction between a given mid-vowel pair was not maintained on the basis of F1 (for the front vowels), the existence of the *loi de position* was taken as an additional indication that final open syllables contain close variants consistently, even where phonemic contrasts are traditionally involved. There was also significant syllabic conditioning of F2. Combining the F2 and F1 analyses, we can draw the following conclusions: final open syllables favour close non-centralised front vowels and close non-centralised back vowels; medial open syllables favour close centralised vowels in the front and back of the vowel space; final closed syllables favour open centralised vowels in the front and back of the vowel space. The correlation between F1 and F2 for the back mid-vowels (lower vowels are more centralised) appears to be linked to this allophonic variation: ‘final closed syllables favour open centralised vowels’ rather than to constitute an independent effect. If it is an ‘independent effect’, this F1/F2 correlation may be indicative of articulatory asymmetry between the close and open areas of the vowel space, on the front-back dimension.

5.1.4 CHANGE IN APPARENT TIME

Beginning with the front mid-vowel pair, old speakers were shown to make the traditional vowel height distinction between /e/ and /ɛ/, while middle speakers, on the other hand, did not make any consistent phonetic distinction between the front mid-vowels. The young generation distinguish between the front mid-vowels on the basis of F2 alone: younger speakers use neither the system of their parents nor their grandparents. The young generation do not distinguish between the front mid-vowels on the basis of vowel height but they do significantly centralise /ɛ/ relative to /e/. Therefore, the traditional SF phonemic distinction, made on the basis of vowel height, is not maintained in RF for young speakers.

For the back mid-vowels, the situation is somewhat different. Old speakers make no phonetic distinction between /o/ and /ɔ/, using /O/ in all positions. I have argued that this is a language contact effect rather than an effect of supralocalisation (see Section 4.4.1.1). Middle speakers make a vowel height distinction between the back mid-vowels: they appear to have established two phonetic categories for the phonemes /o/ and /ɔ/. For young speakers, the data provided some evidence for contrast between the back mid-vowels on the height dimension but the analysis concluded that contextual conditioning appeared to be more important in explaining the variation observed.

We have seen that the *loi de position* predicts open variants in closed syllables and close variants in open syllables. For all three generations, this allophonic vowel height distinction is realised phonetically at a highly significant level for the mid-vowels. We have also seen, however, that the *loi de position* has long been a pervasive feature of southern RF (see Section 2.3.1.1), often overriding

traditional (SF) phonemic distinctions in final open syllables (for the front mid-vowels) and final closed syllables (for the back mid-vowels). The old and young generations also produce contextually conditioned allophones of the front and back mid-vowels on the F2 dimension: syllabic conditioning is also evident in terms of frontness/backness. This is not true of the middle speakers, who only produce allophones that vary in vowel height. Old speakers produce close front vowels in open syllables and open centralised vowels in closed syllables. They realise a tripartite allophonic distinction, however, in the back of the vowel space: close back variants in final open syllables; close centralised variants in medial open syllables; open back variants in final closed syllables. Changing patterns of allophonic variation have resulted in a regular, symmetrical pattern in the younger generation which applies to both the front and back mid-vowels: final open syllables favour close front and close back variants; medial open syllables favour close centralised variants; final closed syllables favour open centralised variants.

5.1.4.1 MODELLING PHONETIC CHANGE IN APPARENT TIME

This section examines phonetic change over time in the mid-vowels. Since some generations distinguish phonetically between the close-mid and open-mid variants of the mid-vowels, while others do not, the conservative SF categories (/e/ /ɛ/ /o/ /ɔ/) are used here to examine diachronic changes in vowel quality: these categories indicate maximal phonetic separation between the mid-vowels. This analysis aims to track linguistic changes in vowel quality for each vowel between the generations. In each case, a mixed-effects regression model including the following fixed effects is used to analyse change in apparent time: speaker age; speaker sex; the interaction between age and sex.

The regression analyses for /e/ are presented in Tables 5.13 and 5.14 for F1 and F2 respectively. In neither case is age returned as a significant predictor of vowel height or vowel frontness. The interaction between age and sex is also returned as non-significant in both models. This shows that the normalised F1 and F2 values do not differ significantly between the generations and that no change in progress is evident for the close-mid front vowel: /e/ occupies a similar position in the normalised vowel space for all speakers. Speaker sex is returned by the analysis as a significant predictor of vowel height for /e/ ($p \leq 0.01$): male speakers favour higher F1 values (lower vowels) than female speakers who favour low F1 values (higher vowels). The magnitude of this effect is relatively small but nonetheless highly significant.

Dependent variable = F1 N = 630 Grand mean = -0.348		Deviance: 1000 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Sex	Male	0.065	334	0.00375
	Female	-0.065	296	
Non-significant factor groups were Age (p=0.149) and Age*Sex (p=0.793).				

Table 5.13. Three generations, all speakers: regression model for /e/ F1.

Dependent variable = F2 N = 630 Grand mean = 0.905	Deviance: 967 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.336), Sex (p=0.217) and Age*Sex (p=0.776).	

Table 5.14. Three generations, all speakers: regression model for /e/ F2.

Tables 5.15 and 5.16 present the regression analyses for F1 and F2, examining phonetic change in /e/. For F1, both speaker sex and age are returned as non-significant predictors, as well as the age-sex interaction terms. This shows that

vowel height is relatively stable across the generations in the normalised vowel space. For F2, on the other hand, speaker sex ($p \leq 0.05$) and age ($p \leq 0.01$) are returned by the analysis as significant predictors of vowel frontness. The age-sex interaction term is not retained as significant. The significant effect for speaker sex reveals male speakers to favour fronter vowels than female speakers who favour more centralised realisations of / ϵ /. The regression coefficients show that the effect magnitude is relatively small. The significant effect for age shows vowel frontness to vary between the generations: old speakers favour fronter realisations of / ϵ / than both middle and young generations, who favour centralised variants. This backing of / ϵ / may contribute, for the younger generation, to the significant phonetic distinction between / e / and / ϵ / made on the basis of F2 (see Section 5.4.1). On the other hand, the favouring effects for centralisation of / ϵ / are of similar magnitude for middle and young speakers suggesting perhaps that this is a change the has come to completion. In fact, a supplementary regression analysis, comparing the middle and young speakers, showed that there is no significant F2 difference between the generations ($p=0.765$) for / ϵ /. There was, however, a significant difference between middle and young speakers (grouped together) and the older generation ($p=0.00245$).

Dependent variable = F1 N = 701 Grand mean = 0.437	Deviance: 1335 Degrees of freedom: 9
Non-significant factor groups were Age ($p=0.24$), Sex ($p=0.948$) and Age*Sex ($p=0.763$).	

Table 5.15. Three generations, all speakers: regression model for / ϵ / F1.

Dependent variable = F2 N = 701 Grand mean = 0.653		Deviance: 916 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Sex	Male	0.035	341	0.045
	Female	-0.035	360	
Age	Old	0.079	246	0.00969
	Young	-0.032	230	
	Middle	-0.046	225	
Non-significant factor groups were Age*Sex (p=0.65).				

Table 5.16. Three generations, all speakers: regression model for /ε/ F2.

The regression models for /o/ are presented in Tables 5.17 and 5.18 for F1 and F2 respectively. For F1, no significant predictors are returned by the analysis. This shows that the normalised vowel height of /o/ is constant across sexes and across generations. The regression model for F2 in /o/ (Table 5.18) returns all fixed-effect factor groups as non-significant: speaker sex and speaker age cannot accurately predict the variation observed in F2. We can conclude from this that, in the normalised vowel space, /o/ occupies a similar relative position for male and female speakers in all age groups.

Dependent variable = F1 N = 788 Grand mean = -0.229	Deviance: 1423 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.157), Sex (p=0.139) and Age*Sex (p=0.212).	

Table 5.17. Three generations, all speakers: regression model for /o/ F1.

Dependent variable = F2 N = 788 Grand mean = -0.921	Deviance: 1303 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.319), Sex (p=0.405) and Age*Sex (p=0.293).	

Table 5.18. Three generations, all speakers: regression model for /o/ F2.

For the final vowel /ɔ/, the regression models for phonetic change in F1 and F2 are presented in Tables 5.19 and 5.20, respectively. The F1 model returns speaker sex, age and the age-sex interaction term as non-significant predictors of the variation observed: the vowel height of /ɔ/ is again relative stable in the normalised data set. The F2 model, in Table 5.20, includes speaker age as a significant predictor ($p \leq 0.05$) while sex and the age*sex interaction were returned as non-significant. The significant effect for age shows young speakers to have the most centralised /ɔ/ vowel, the middle speakers to have the most ‘back’ vowel and the older speakers to be intermediate to the two other generations with a tendency to favour back realisations. The centralisation of /ɔ/ may therefore be seen as a characteristic of the younger generation. A regression analysis comparing young speakers to all other speakers (middle and old generations grouped together) reveals this to be true ($p = 0.0152$) and a regression analysis comparing only the middle and old speakers showed that there is not significant difference between the two generations ($p = 0.465$). This confirms that /ɔ/-centralisation is characteristic of younger speakers.

Dependent variable = F1 N = 520 Grand mean = 0.152	Deviance: 1069 Degrees of freedom: 9
Non-significant factor groups were Age ($p = 0.748$), Sex ($p = 0.779$) and Age*Sex ($p = 0.926$).	

Table 5.19. Three generations, all speakers: regression model for /ɔ/ F1.

Dependent variable = F2 N = 520 Grand mean = -0.855		Deviance: 541 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Young	0.072	179	0.0393
	Old	-0.018	155	
	Middle	-0.053	186	
Non-significant factor groups were Sex (p=0.183) and Age*Sex (p=0.314).				

Table 5.20. Three generations, all speakers: regression model for /ɔ/ F2.

SUMMARY OF APPARENT-TIME PHONETIC CHANGE IN THE MID-VOWELS

Different trajectories of phonetic change have been revealed for each of the front mid-vowels, /e/ and /ɛ/. For /e/, speaker sex was shown to affect vowel height in that male speakers realised the vowel as significantly lower than female speakers. The quality of this vowel was shown to occupy a stable position, relative to the other vowels in the vowel space, across the generations. This was true for both vowel height and vowel frontness. For /ɛ/, speaker sex was shown to affect vowel frontness, with female speakers using more centralised vowels than male speakers. Speaker age was also shown to affect vowel quality on the front-back dimension: older speakers favoured fronter realisations of /ɛ/ while middle and young speakers favoured centralised variants. In Section 5.1.4, we saw the following evidence for phonological change in the front mid-vowels: older speakers make a significant vowel height distinction between /e/ and /ɛ/; middle speakers make no significant distinction between /e/ and /ɛ/: younger speakers make a significant front-centralised distinction between /e/ and /ɛ/. The evidence for phonetic change presented above, when the vowels are considered individually, can shed some light on the linguistic mechanisms that have resulted in these different phonological

patterns: the significant centralisation of /ɛ/, for example, by the younger generation allows younger speakers to differentiate it from /e/ (since they do not make a significant vowel height distinction between the vowels).

For the back mid-vowel /o/, the relative position was stable across the generations and for male and female speakers. No significant phonetic change was established for the close-mid vowel. For the open-mid vowel /ɔ/, on the other hand, speaker age was found to be a significant predictor of vowel backness: younger speakers favoured centralised realisations of /ɔ/; middle and older speakers favoured back realisations. The patterns of phonological change presented in Section 5.1.4 were as follows: old speakers did not make any significant distinction between /o/ and /ɔ/; middle speakers distinguished between /o/ and /ɔ/ on the basis of vowel height alone; young speakers distinguished between /o/ and /ɔ/ on the basis of vowel height and (to some extent) vowel backness. Again, the significant phonetic change in /ɔ/ whereby young speakers are using more centralised variants appears to explain the changing phonological patterns observed between the generations.

The non-significant results for ‘age’ in all four F1 models are problematic when compared with the categorical patterns summarised in Section 5.1.4: the stability in vowel height implied by these non-significant results does not reflect the changing phonological patterns observed across the generations. For example, the older generation distinguish between the front mid-vowels on the basis of F1 but the middle and young generations do not. There is, however, no evidence of significant phonetic change in F1 when the middle and younger generations are compared with older speakers. For the back mid-vowels on the other hand, no phonetic change is

evident in F1 for /o/ or /ɔ/ which would explain the diachronic change from the use of one phonetic category (older generation) to the use of two phonetic categories (for middle speakers). Again, the analyses presented above imply stability over time for the relative positions of the back mid-vowels, perhaps contradicting the phonological patterns presented previously.

5.2 FRENCH NASAL VOWELS

The analysis of the French nasal vowels examines variations in vowel quality and nasal consonant occurrence in each generation. At each stage of the analysis, sequential and non-sequential units will be examined separately and attention will be paid to both phonological and phonetic variation. The former is primarily discussed in relation to evidence for the supralocal merger of the front nasal vowels, /*ẽ*/ and /*œ*/, to /*ẽ*/. The examination of phonetic variation focuses on the relative positions of the nasal vowels within the vowel space and the factors affecting variation in the vowels when considered individually. The synchronic models for each parameter in each of the three generations are then compared qualitatively to investigate possible change in the nasal vowel system in apparent time. Following this, phonetic change over time in each of the nasal vowels is modelled statistically, focusing on the effects of age and speaker sex and the interaction of these factors on vowel quality and consonant absence/presence.

5.2.1 OLDER GENERATION

The examination of phonological contrast between the nasal vowels in the older generation focused on distinctions between the front nasal vowels (/*ẽ*/ and /*œ*/) and

between the back nasal vowels (/ã/ and /õ/) (see Section 4.4). The front nasal vowels, /ẽ/ and /œ/, are traditionally distinguished on the basis of lip-rounding of the latter (which correlates acoustically with lower F2 and F3 values). There is evidence to suggest that in the supralocal norm the back nasal vowels are also contrasted primarily on the basis of lip-rounding (/õ/ being rounded and /ã/ unrounded). In the front vowels, the variation conformed to the traditional pattern: /œ/ had significantly lower F2 than /ẽ/. In sequential nasal units, /œ/ exhibited significantly lower F3 than /ẽ/, confirming that the vowels are distinguished on the basis of lip-rounding. Older male speakers were also found, however, to use height to distinguish between /ẽ/ and /œ/ in sequential units, with /ẽ/ significantly lower than /œ/³⁹. In non-sequential nasal units, older speakers did not distinguish phonetically on the basis of F3 between /ẽ/ and /œ/. This finding led to the conclusion that the presence of a nasal consonant was linked to degree of merger evident in the front nasal vowels: consonant presence appeared to favour phonetic separation between the traditional phonemes; consonant absence appeared to favour a merged category. For the back nasal vowels, phonemic contrast was evident in both sequential and non-sequential units: /ã/ and /õ/ were distinguished on the basis of F1 and F2, /ã/ being lower and more centralised than /õ/. For F3, by contrast, no significant distinction was made between /ã/ and /õ/ in sequential or non-sequential nasal units.

³⁹ These high /œ/ values, relative to /ẽ/, for male speakers may constitute a contact effect: /œ/ was shown to be significantly correlated to Béarnais /ỹN/ in the language contact study (see Section 4.5.2.2 and, in particular, Tables 4.108-4.110).

Different constraints were found to govern variation in the different nasal vowels in sequential and non-sequential nasal units (see Sections 4.4.1.1, 4.4.1.2 and 4.4.2.1). With the exception of /œ̃/, syllable type proved to be the best predictor of F1 values: final syllables favoured lower vowels for /ẽ̃/, [ãN], and /õ̃/; medial syllables favoured higher vowels for /ẽ̃/, /ã̃/, and /õ̃/. For [ã̃], final open syllables favoured lower vowels and medial syllables favoured higher vowels while vowels in final closed syllables were intermediate between the two. For [ãN], syllable type also had a significant effect on F2: medial syllables favoured central (higher) vowels while final syllables favoured back (lower) vowels. A significant positive correlation was found between F1 and F2 for all nasal vowels (except /œ̃/) in sequential nasal units. In non-sequential units, this F1/F2 positive correlation was only significant for /ã̃/. The only significant predictor established for variation in /œ̃/ was the effect of speaker sex on F1 in sequential nasal units: female speakers have lower vowels than male speakers for [œ̃N]. Finally, lexical frequency effects were found for [ẽ̃] and [ãN]. For [ẽ̃], F1 was negatively correlated with lexical frequency: high frequency words favoured vowel raising. For [ãN], high frequency words favoured (acoustically) front/central vowels while low frequency words favoured backed variants.

Finally, the presence of a nasal coda was shown to be conditioned by syllable type (see Section 4.4.3.1): closed final and open medial syllables favour consonant presence; open final syllables favour consonant absence. Male speakers were also shown to use more consonantal codas than female speakers and the phonemic identity of the nasal unit was shown to condition consonant absence/presence for

male speakers but not for female speakers: /ɔ̃/ favoured consonant presence, followed by /ã/, while /œ̃/ and /ɛ̃/ contained significantly fewer nasal consonant codas in the nasal units.

5.2.2 MIDDLE GENERATION

Table 5.21 presents the token counts included in the analysis of the nasal vowels, divided into sequential and non-sequential nasal units, for the middle generation of speakers. Across all four vowels, the general pattern is one in which the presence of a nasal consonant is the majority form. This is particularly true of the front nasal vowels.

Sex	Speaker	/ɛ̃/		/œ̃/		/ã/		/ɔ̃/	
		[ɛ̃N]	[ɛ̃]	[œ̃N]	[œ̃]	[ãN]	[ã]	[ɔ̃N]	[ɔ̃]
F	K	21	13	12	4	27	18	28	18
	L	26	4	15	3	39	5	39	4
	M	27	14	9	6	20	24	32	16
	N	34	3	11	6	18	21	21	21
	O	27	16	10	5	23	21	30	14
M	P	31	7	9	4	24	20	32	13
	Q	24	6	13	3	20	21	33	13
	R	36	5	12	3	42	4	36	9
	S	34	7	14	1	33	12	34	11
	T	29	7	12	3	26	20	31	14
Total		289	82	117	38	272	166	316	133

Table 5.21. Token counts for French nasal vowels by ‘Middle’ speakers (F = female; M = male).

This section focuses on vowel quality by examining F1 and F2 values in turn for male and female speakers, and sequential and non-sequential nasal units. The F1 and F2 values for vowels in sequential nasal units produced by middle-generation male speakers are plotted in Figure 5.9. The general position of the vowels relative to each

other conforms largely to the schematised vowel space presented in Figure 4.24 above. There is a tendency for tokens of [œ̃] to have lower F2 values than [ɛ̃], when all male speakers are considered together. There is overlap evident between all of the nasal vowels in the central area of the vowel space.

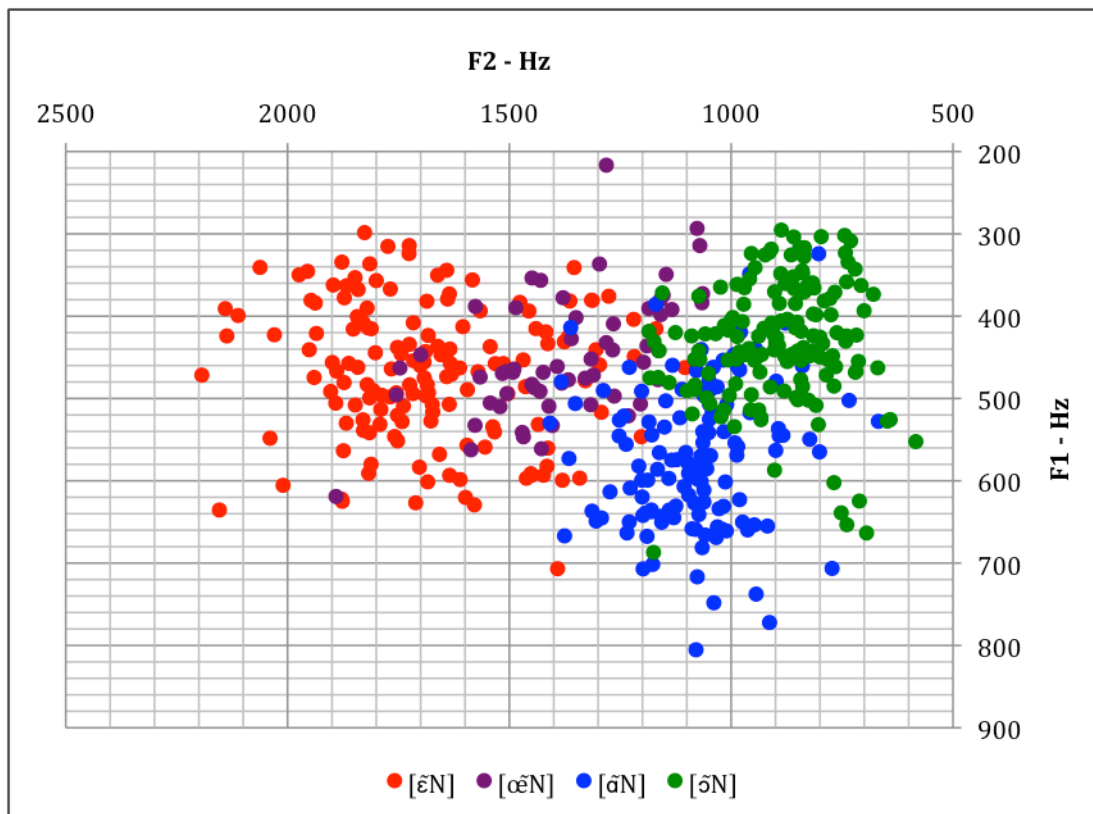


Figure 5.9. Middle Male Speakers: F1 and F2 values for nasal vowels in sequential (ṽN) nasal units.

Figure 5.10 presents the mean F1 and F2 values and standard deviations for the nasal vowels in sequential nasal units for individual male speakers. With the exception of Speaker T, all male speakers exhibit separation between the front and back vowels. Speaker T has some overlap between the [œ̃N] and [ɑ̃N]. For the front nasal vowels, all male speakers exhibit separation between the mean F2 values for [ɛ̃N] and [œ̃N]: only Speaker Q has overlap on this dimension, the others showing various degrees of separation. For the back vowels, the mean value of [ɑ̃N] is lower

and slightly more centralised than that of [ɔ̃N] for all speakers and there is minimal overlap. There is some F1 overlap, at least for Speaker S who has a high level of variability for [ɑ̃N].

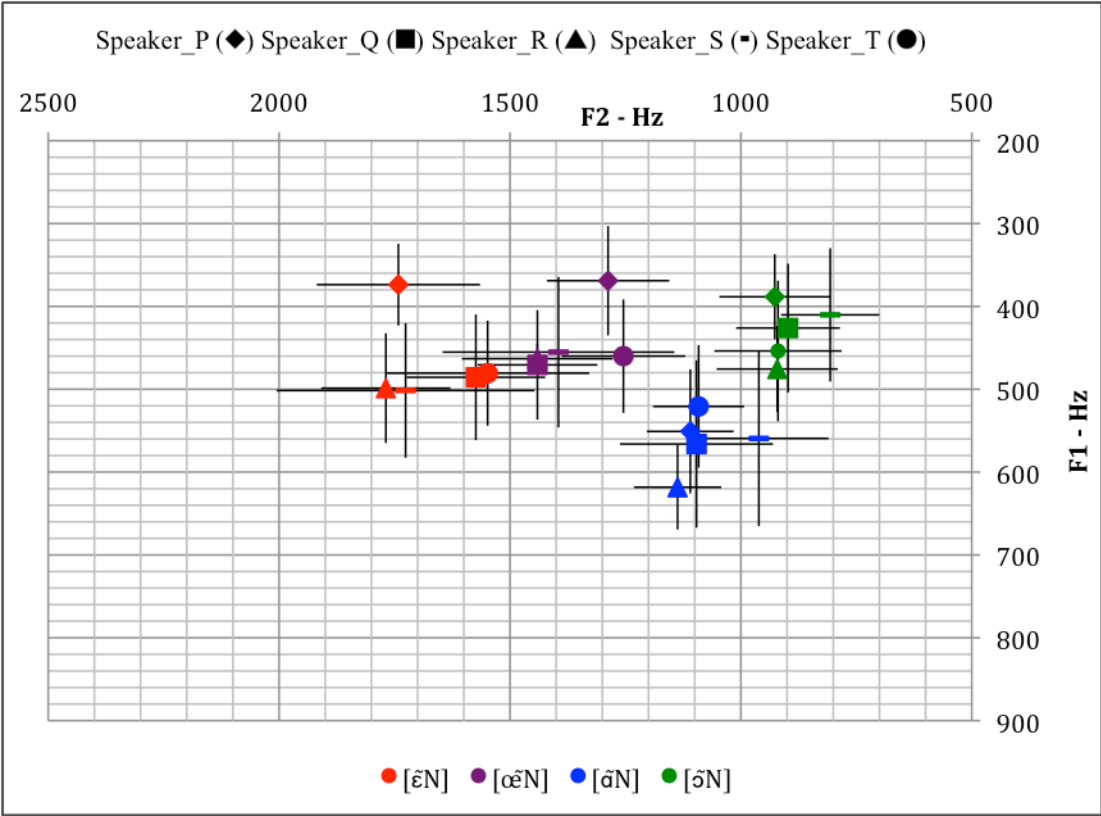


Figure 5.10. Middle Male Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in sequential ($\tilde{v}$ N) nasal units .

Figure 5.11 presents the non-sequential nasal tokens for the middle-generation male speakers. The general position of the vowels relative to each other conforms to the schematised model but there is overlap between all nasal vowels on both the F1 and F2 dimensions.

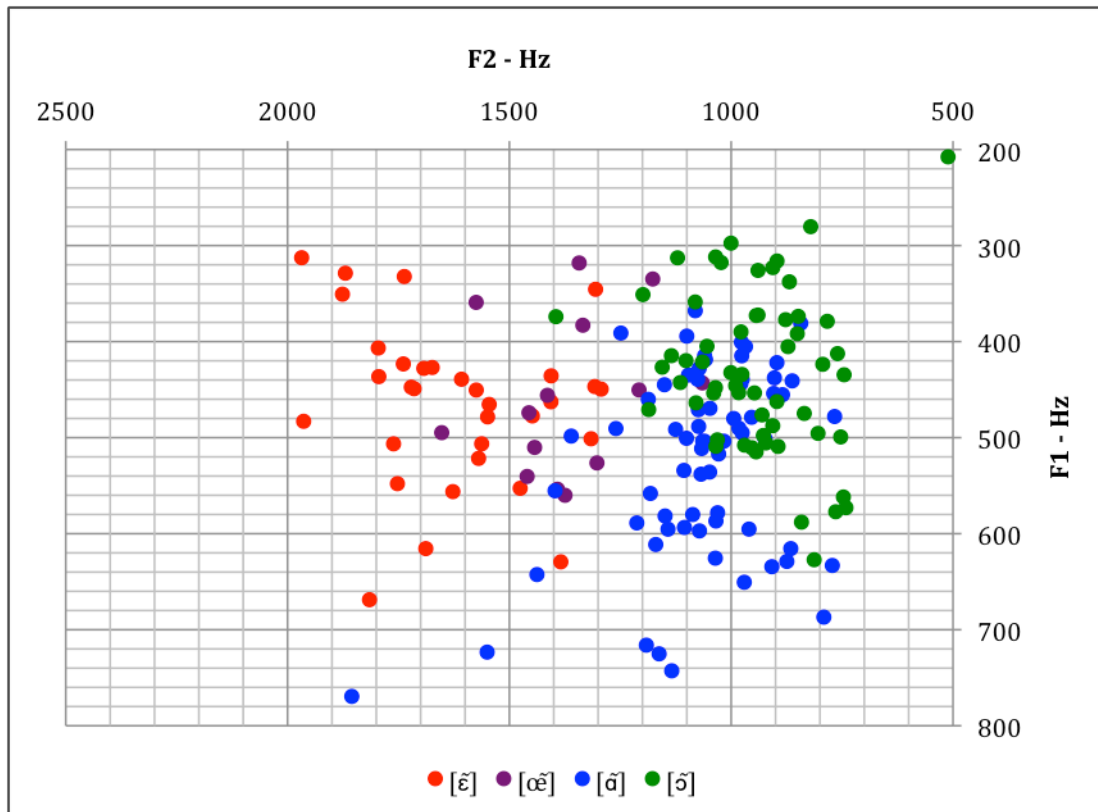


Figure 5.11. Middle Male Speakers: F1 and F2 values for nasal vowels in non-sequential (ñ) nasal units.

The mean F1 and F2 values and standard deviations are presented in Figure 5.12 for individual speakers. Again, all speakers show separation between the front and back nasal vowels with the exception of Speaker T who exhibits overlap between [œ̃] and [ã]. Speakers P and S show F2 separation between the front vowels, [ẽ] and [œ̃] but the [œ̃] datapoint for Speaker S is based on only one token. The other speakers all exhibit overlapping distributions between the front vowels. Speaker R is particularly worthy of note, exhibiting full separation between the vowels in sequential nasal units and overlapping distributions in non-sequential units. This parallels the situation witnessed in the older generation, where consonant presence appeared to facilitate the retention of a four-term nasal vowel system. All speakers have separation between the mean values of the back nasal vowels, [ã] and [õ]: [ã] is lower and slightly more centralised than [õ]. Speakers P, R and T exhibit

separation between the distributions of the back nasal vowels while Speakers Q and S show at least some overlap between the vowels.

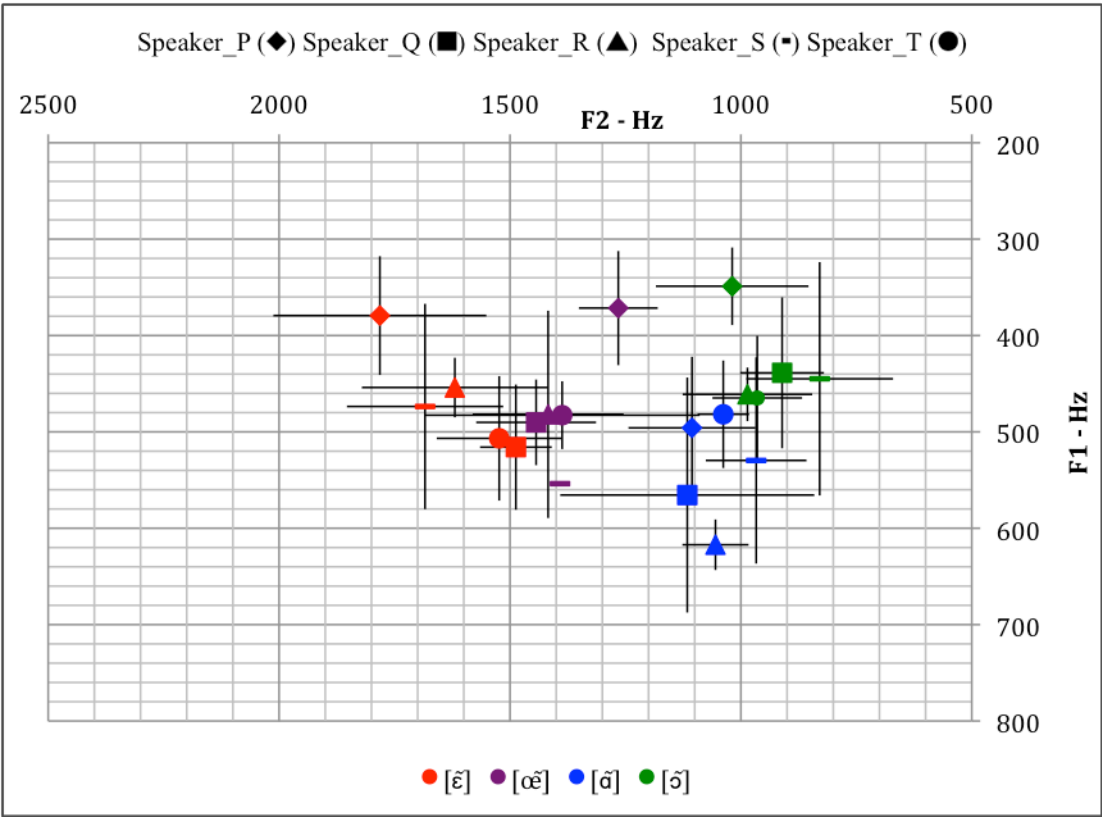


Figure 5.12. Middle Male Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in non-sequential (ñ) nasal units.

The F1 and F2 values for all vowels produced in sequential nasal units by female speakers in the middle generation are plotted in Figure 5.13. The general relative position of the vowels is as expected with overlap evident between all vowels on both the F1 and F2 dimensions when all speakers are considered together.

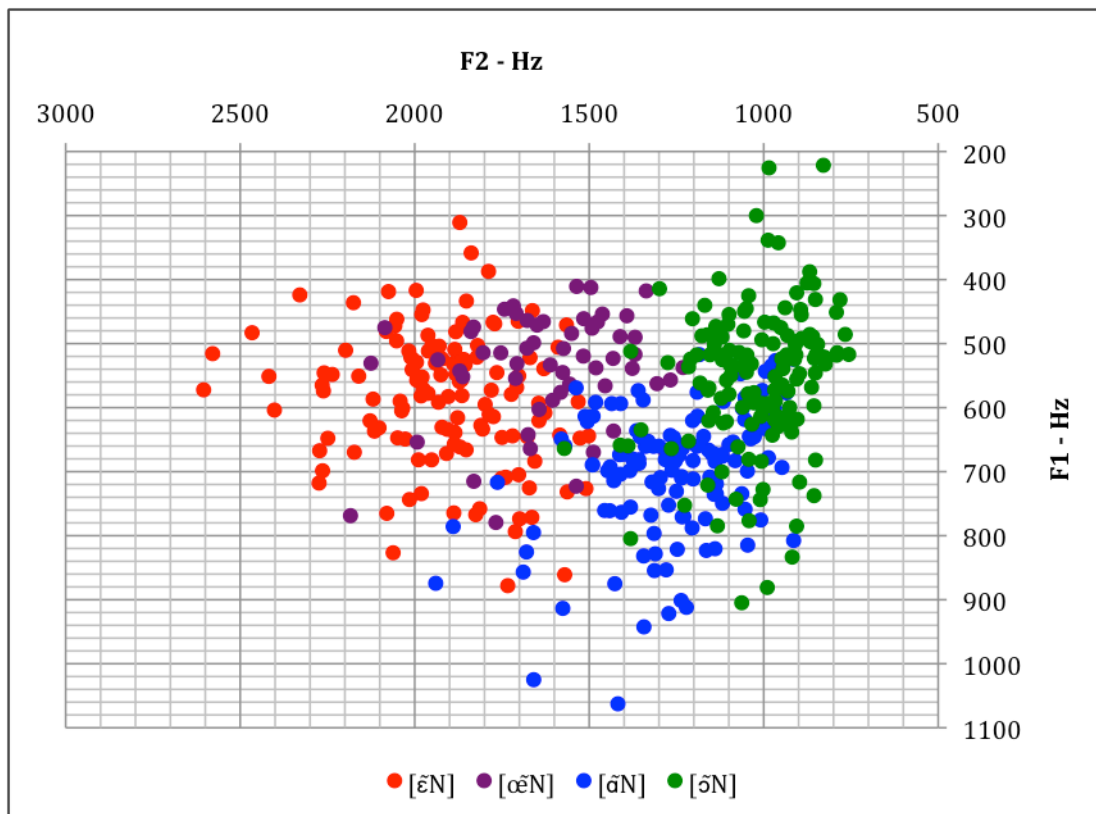


Figure 5.13. Middle Female Speakers: F1 and F2 values for nasal vowels in sequential ($\tilde{v}N$) nasal units.

The mean F1 and F2 values and standard deviations for the vowels in sequential nasal units are presented in Figure 5.14 for individual speakers. All speakers show separation between the front and back nasal vowels. For most speakers, the front vowels are distinguished by F2 rather than F1 (with the exception of Speaker L), although with varying degrees of overlap. For the back nasal vowels, all speakers show separate distributions for [ɑ̃N] and [ɔ̃N] with the mean values of the former being lower and more centralised than the latter.

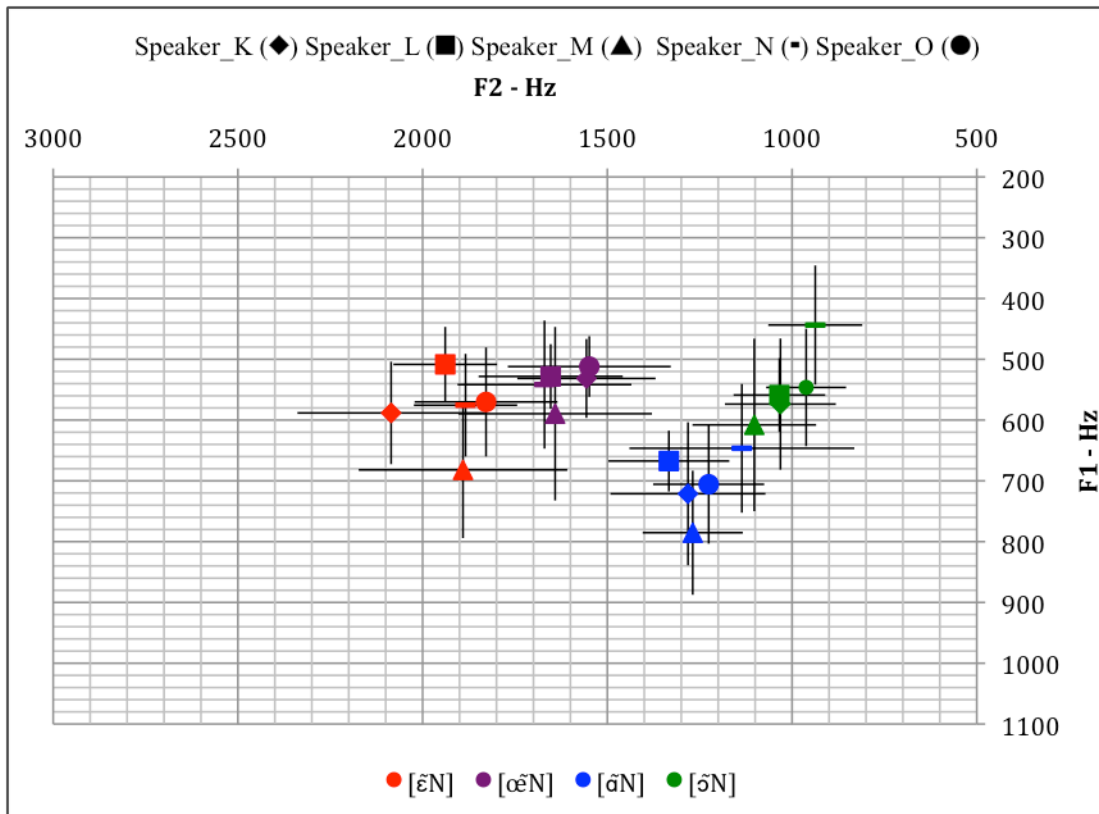


Figure 5.14. Middle Female Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in sequential ($\tilde{v}N$) nasal units.

Figure 5.15 presents the vowel tokens in non-sequential nasal units for female speakers in the middle generation. Again, the general position of the vowels relative to each other is as expected with overlap between all nasal vowels on both axes.

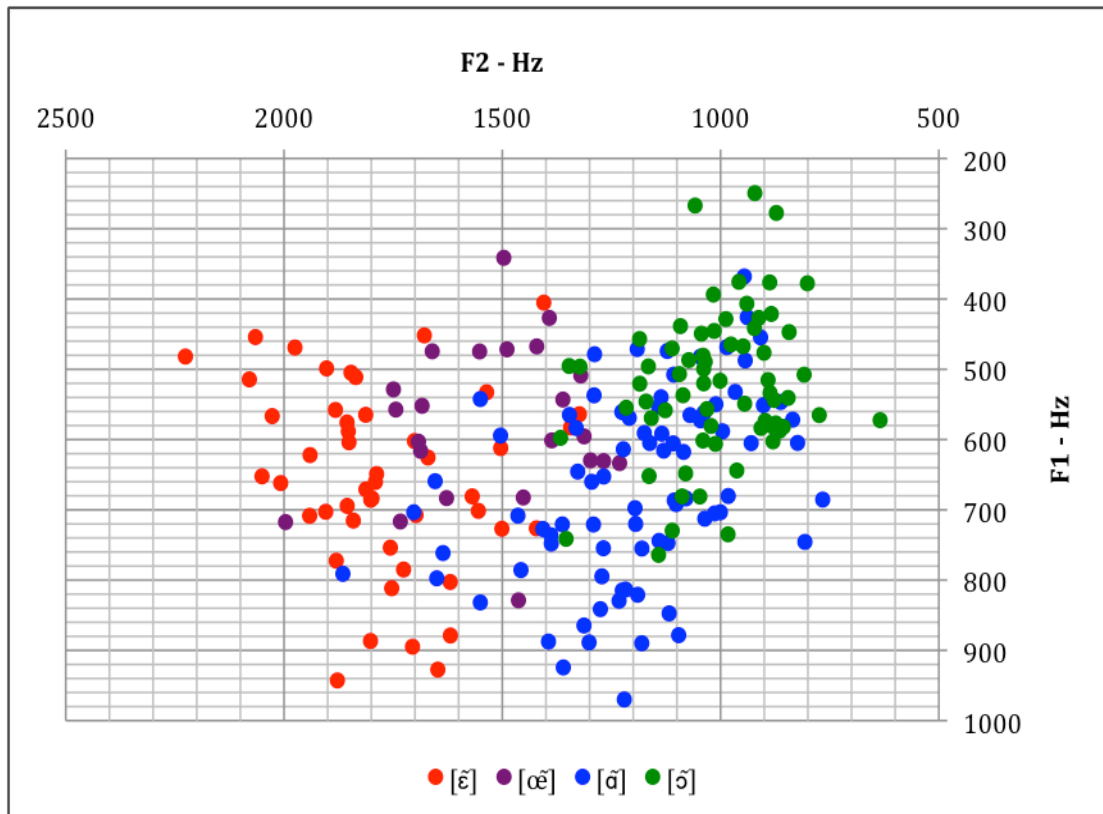


Figure 5.15. Middle Female Speakers: F1 and F2 values for nasal vowels in non-sequential ($\tilde{v}$) nasal units.

The mean F1 and F2 values and standard deviations for vowels in non-sequential nasal units are provided in Figure 5.16 for individual female speakers. Overlap is evident between [œ̃] and [ã] for Speakers K and N but the front and back nasal vowels are fully separated for other female speakers. For the front nasal vowels, the mean F2 values for [ẽ] are higher for all speakers than those of [œ̃] but speakers vary in the amount of separation they exhibit between their distributions: Speakers K and L show complete separation; Speakers M and O show a small amount of overlap between the vowels; Speaker N exhibits substantially overlapping distributions. For the back nasal vowels, the tendency is for mean values of [ã] to be lower and centralised relative to [õ]. All speakers, with the exception of Speaker O, exhibit separation between the distributions of the back nasal vowels.

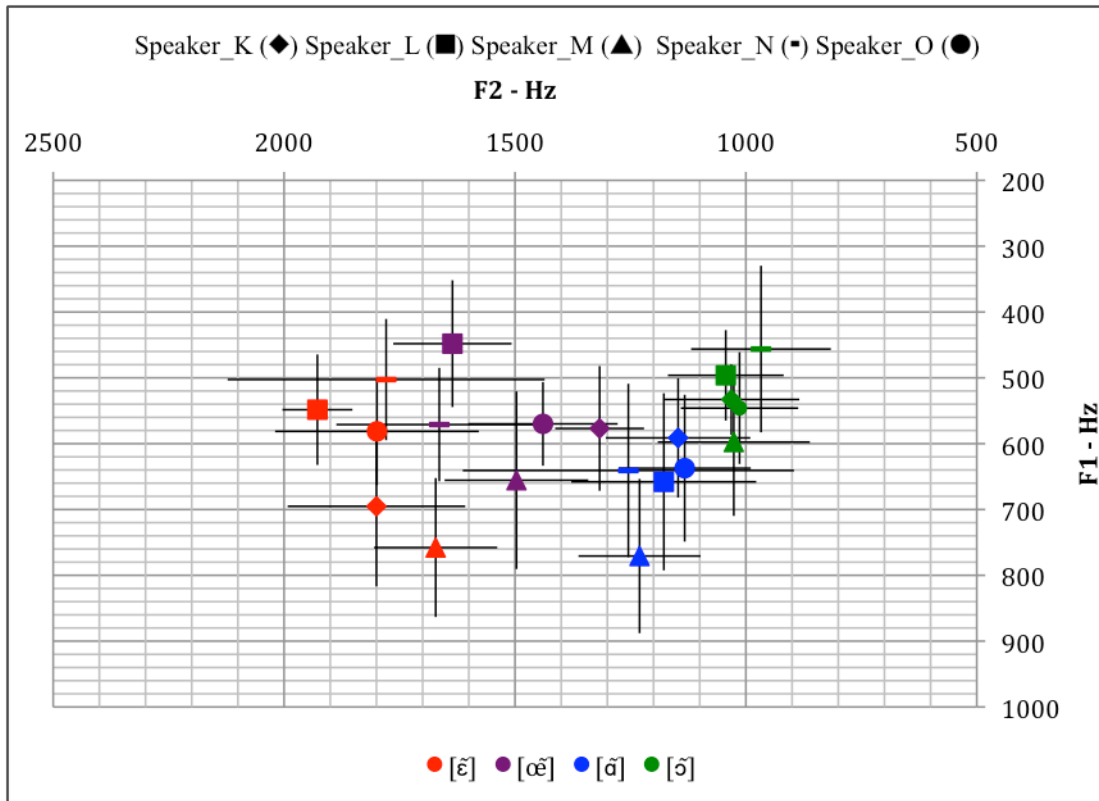


Figure 5.16. Middle Female Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in non-sequential (ñ) nasal units.

5.2.2.1 MODELLING SEQUENTIAL AND NON-SEQUENTIAL NASAL UNITS

The regression analyses for F1 and F2 values for /ẽ/ in sequential nasal units are presented in Table 5.22 and Table 5.23. While there are no significant predictors for F2, syllable type is the only significant predictor of F1: final syllables favour high F1 values (or lower vowels) while medial syllables favour low F1 values (or higher vowels).

Nasal Unit = [ẽN] Dependent variable = F1 N = 289 Grand mean = -0.15		Deviance: 623 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/CṽC#/	0.138	82	0.0182
	/Cṽ#/	0.109	94	
	/ṽCV(C)#/	-0.247	113	
Non-significant factor groups were Speaker sex (p=0.471), F2 (p=0.471), and Lexical frequency (p=0.882).				

Table 5.22. All Middle speakers: Results of mixed-effects regression for F1 in [ɛ̃N].

Nasal Unit = [ɛ̃N] Dependent variable = F2 N = 289 Grand mean = 1.274	Deviance: 433 Degrees of freedom: 9
Non-significant factor groups were Lexical frequency (p=0.177), Syllable type (p=0.182), F1 (p=0.534), and Speaker sex (p=0.722).	

Table 5.23. All Middle speakers: Results of mixed-effects regression for F2 in [ɛ̃N].

Identical regression analyses, considering F1 and F2 for /ɛ̃/ in non-sequential nasal units are presented in Tables 5.24 and 5.25. For F1, two significant predictors are included in the model: syllable type ($p \leq 0.01$) and lexical frequency ($p \leq 0.05$). Final open syllables are shown to favour high F1 values (lower vowels) while final closed syllables, and particularly medial open syllables, favour low F1 values (higher vowels). The ranking of syllabic conditioning differs between sequential and non-sequential units. The analysis of F2 in non-sequential units also showed syllable type to be the only significant predictor of the variation observed. Viewed together with F1, the pattern revealed is as follows: open more centralised vowels in final open syllables; closer intermediate vowels in medial open syllables; close more front vowels in final closed syllables. Lexical frequency exhibits a negative correlation with F1: high frequency lexical items contained vowels that are higher in the vowel space than those in low frequency items.

Nasal Unit = [ẽ] Dependent variable = F1 N = 82 Grand mean = 0.106		Deviance: 188 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C $\tilde{v}$ #/	0.433	48	0.00544
	/C $\tilde{v}$ C#/	-0.108	11	
	/ $\tilde{v}$ CV(C)#/	-0.325	23	
Lexical frequency	Continuous (log-transformed)	-0.281	82	0.0402
Non-significant factor groups were F2 (p=0.137) and Speaker sex (p=0.239).				

Table 5.24. All Middle speakers: Results of mixed-effects regression for F1 in [ẽ].

Nasal Unit = [ẽ] Dependent variable = F2 N = 82 Grand mean = 1.015		Deviance: 117 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/CṽC#/	0.140	11	0.0261
	/ṽCV(C)#/	0.092	23	
	/Cṽ#/	-0.233	48	
Non-significant factor groups were Speaker sex (p=0.116), F1 (p=0.162) and Lexical frequency (p=0.305).				

Table 5.25. All Middle speakers: Results of mixed-effects regression for F2 in [ẽ].

The regression analyses for F1 and F2 in /œ̃/ in sequential nasal units are presented in Tables 5.26 and 5.27. In both cases, a positive F1/F2 correlation is shown to be the only significant predictor of the variation observed: increases in F1 entail increases in F2 and the opposite is also true. The magnitude of this effect is relatively high in both models and the effect is highly significant ($p \leq 0.01$). This means that higher [œ̃N] vowels are significantly fronter than lower [œ̃N] vowels.

Nasal Unit = [œN] Dependent variable = F1 N = 117 Grand mean = -0.426		Deviance: 240 Degrees of freedom: 8		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.354	117	0.00297
Non-significant factor groups were Speaker sex (p=0.165), Lexical frequency (p=0.501), and Syllable type (p=0.737).				

Table 5.26. All Middle speakers: Results of mixed-effects regression for F1 in [œN].

Nasal Unit = [œN] Dependent variable = F2 N = 117 Grand mean = 0.475		Deviance: 184 Degrees of freedom: 8		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous	0.219	117	0.00264
Non-significant factor groups were Speaker sex (p=0.351), Syllable type (p=0.424), and Lexical frequency (p=0.774).				

Table 5.27. All Middle speakers: Results of mixed-effects regression for F2 in [œN].

For non-sequential nasal units, the regression analyses for F1 and F2 are presented in Tables 5.28 and 5.29. In both cases, no significant predictors are included in the statistical models: importantly, the F1/F2 correlation observed in the sequential nasal units is not returned as significant. Note that the sequential and non-sequential regression analyses are not identical in that syllable type is not included as a factor group in the non-sequential analyses: only vowels in final open syllables occur in nasal units without nasal consonant codas.

Nasal Unit = [œ] Dependent variable = F1 N = 38 Grand mean = -0.25	Deviance: 88 Degrees of freedom: 7
Non-significant factor groups were F2 (p=0.222), Lexical frequency (p=0.529), and Speaker sex (p=0.623).	

Table 5.28. All Middle speakers: Results of mixed-effects regression for F1 in [œ].

Nasal Unit = [œ̃] Dependent variable = F2 N = 38 Grand mean = 0.327	Deviance: 58 Degrees of freedom: 7
Non-significant factor groups were F1 (p=0.197), Speaker sex (p=0.486), and Lexical frequency (p=0.659).	

Table 5.29. All Middle speakers: Results of mixed-effects regression for F2 in [œ̃].

Having investigated the constraints on the front nasal vowels, considering them separately, we can now examine the basis on which they are distinguished phonetically focusing on F1 and F2. The analyses of F1 are presented in Tables 5.30 and Table 5.31 for sequential and non-sequential nasal units respectively. In each case, ‘phoneme’ is returned as a non-significant predictor of F1 values, as is speaker sex (and the phoneme*sex interaction term). This means that speakers in the middle generation do not distinguish between /ẽ/ and /œ̃/ on the basis of F1 (or vowel height) which is not surprising given that they are traditionally distinguished on the basis of lip-rounding.

Nasal Unit = [ẽN œ̃N] Dependent variable = F1 N = 406 Grand mean = -0.23	Deviance: 886 Degrees of freedom: 7
Non-significant factor groups were Phoneme (p=0.111), Speaker sex (p=0.296), and Phoneme*Sex (p=0.607).	

Table 5.30. All Middle speakers: Results of mixed-effects regression for F1 in [ẽN œ̃N].

Nasal Unit = [ẽ œ̃] Dependent variable = F1 N = 120 Grand mean = -0.007	Deviance: 289 Degrees of freedom: 7
Non-significant factor groups were Phoneme (p=0.404), Speaker sex (p=0.734), and Phoneme*Sex (p=0.161).	

Table 5.31. All Middle speakers: Results of mixed-effects regression for F1 in [ẽ œ̃].

For F2, on the other hand, ‘phoneme’ is returned as a highly significant predictor of F2, as shown in Tables 5.32 and 5.33: /ẽ/ favours significantly higher F2 values than

/œ/. These lower F2 values for /œ/ are most likely an acoustic correlate of lip-rounding suggesting that the traditional SF distinction is maintained by these speakers and that the supralocal merger to /ẽ/ has not been adopted. The magnitude of this effect is near-identical in sequential and non-sequential nasal units as is its strength.

Nasal Unit = [ɛ̃N œ̃N] Dependent variable = F2 N = 406 Grand mean =		Deviance: 649 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ɛ̃/	0.359	289	9.01e-05
	/œ̃/	-0.359	117	
Non-significant factor groups were Speaker sex (p=0.926) and Phoneme*Sex (p=0.341).				

Table 5.32. All Middle speakers: Results of mixed-effects regression for F2 in [ẽN œN].

Nasal Unit = [ɛ̃ œ̃] Dependent variable = F2 N = 120 Grand mean = 0.798		Deviance: 190 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ɛ̃/	0.357	82	0.000182
	/œ̃/	-0.357	38	
Non-significant factor groups were Speaker sex (p=0.148), and Phoneme*Sex (p=0.846).				

Table 5.33. All Middle speakers: Results of mixed-effects regression for F2 in [ẽ œ].

Moving on to the back nasal vowels and beginning with /ã/ in sequential nasal units, the F1 and F2 analyses are presented in Tables 5.34 and 5.35 respectively. The regression model for F1 includes two significant predictors of the variation observed: F2 ($p \leq 0.01$) and syllable type ($p \leq 0.01$). F1 is shown to be positively correlated to F2: lower vowels are significantly fronter than higher vowels.

The magnitude of this effect is large and probability of observing it is very high. F1 is also significantly conditioned by syllable type: final closed syllables favour lower vowels; medial syllables favour centralised (or higher) vowels; vowels in final open syllables are intermediate. The F1/F2 correlation is also returned by the F2 model as highly significant. Additionally, F2 is shown to be negatively correlated to lexical frequency: high frequency lexical items are shown to be significantly fronter (non-standard variants) than low frequency lexical items which are further back in the vowel space (more standard variants). High frequency words appear to contain more regional variants of /ã/ than low frequency words when they occur in nasal units with consonantal codas.

Nasal Unit = [ãN] Dependent variable = F1 N = 272 Grand mean = 0.819		Deviance: 688 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.649	272	1.84e-09
Syllable type	/C $\tilde{v}$ C#/	0.195	95	0.0098
	/C $\tilde{v}$ #/	0.050	79	
	/ $\tilde{v}$ CV(C)#/	-0.245	98	
Non-significant factor groups were Lexical frequency (p=0.283) and Speaker sex (p=0.575)				

Table 5.34. All Middle speakers: Results of mixed-effects regression for F1 in [ãN].

Nasal Unit = [ãN] Dependent variable = F2 N = 272 Grand mean = -0.335		Deviance: 357 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.192	272	1.72e-09
Lexical frequency	Continuous (log-transformed)	-0.105	272	0.0295
Non-significant factor groups were Syllable type (p=0.39) and Speaker sex (p=0.534)				

Table 5.35. All Middle speakers: Results of mixed-effects regression for F2 in [ãN].

The models of F1 and F2 for /ã/ in non-sequential nasal units are presented in Tables 5.36 and 5.37. For F1, the same fixed effect factor groups are returned as significant: F2 ($p \leq 0.01$) and syllable type ($p \leq 0.01$). The positive F1/F2 correlation observed in sequential nasal units is also present in the non-sequential F1 and F2 models: higher vowels are again further back in the vowel space than lower vowels. Vowel height is also conditioned by syllable type: final syllables favour low vowels while medial syllables favour centralised (higher) vowels. This syllable effect is slightly different to that observed in sequential nasal units but in both cases, medial syllables can be seen to contain higher centralised vowels than final syllables.

Nasal Unit = [ã] Dependent variable = F1 N = 166 Grand mean = 0.353		Deviance: 447 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.748	166	7.17e-10
Syllable type	/Cṽ#/	0.208	75	0.00785
	/CṽC#/	0.141	49	
	/ṽCV(C)#/	-0.349	42	
Non-significant factor groups were Speaker sex (p=0.66) and Lexical frequency (p=0.737).				

Table 5.36. All Middle speakers: Results of mixed-effects regression for F1 in [ã].

Nasal Unit = [ã] Dependent variable = F2 N = 166 Grand mean = -0.415		Deviance: 276 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.27	166	6.4e-10
Non-significant factor groups were Syllable type (p=0.0811), Lexical frequency (p=0.575), and Speaker sex (p=0.847).				

Table 5.37. All Middle speakers: Results of mixed-effects regression for F2 in [ã].

The regression models for F1 and F2 of /ĩ/ in sequential nasal units are presented in Tables 5.38 and 5.39. Both models include a significant positive F1/F2 correlation ($p \leq 0.01$): lower [ĩN] vowels are also significantly centralised while higher vowels are further back. There is also a significant effect of syllable type on F1 ($p \leq 0.05$): final closed syllables favour lower vowels than medial syllables; final open syllables contain vowels which are intermediate to the two. This is the same as the pattern observed above for [ãN].

Nasal Unit = [ɔ̃N] Dependent variable = F1 N = 316 Grand mean = -0.388		Deviance: 766 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.541	316	4.94e-12
Syllable type	/Cɔ̃C#/	0.149	123	0.0183
	/Cɔ̃#/	0.094	76	
	/ɔ̃CV(C)#/	-0.243	117	
Non-significant factor groups were Lexical frequency (p=0.102) and Speaker sex (p=0.588)				

Table 5.38. All Middle speakers: Results of mixed-effects regression for F1 in [ɔ̃N].

Nasal Unit = [ɔ̃N] Dependent variable = F2 N = 316 Grand mean = -0.83		Deviance: 514 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.241	316	5.25e-11
Non-significant factor groups were Lexical frequency (p=0.754), Speaker sex (p=0.765), and Syllable type (p=0.987).				

Table 5.39. All Middle speakers: Results of mixed-effects regression for F2 in [ɔ̃N].

The same analyses of F1 and F2 for /ɔ̃/ in non-sequential nasal units are presented in Tables 5.40 and 5.41. Again, the positive F1/F2 correlation is returned by both models as significant but at a lower significance level than in sequential nasal units ($p \leq 0.05$). The syllabic conditioning of F1 patterns differently in non-sequential units: final syllables favour higher F1 values (lower vowels); medial syllables favour low F1 values (higher vowels). Again, this syllabic conditioning pattern is similar to that observed above for [ã] vowels in non-sequential units.

Nasal Unit = [ɔ̃] Dependent variable = F1 N = 113 Grand mean = -0.484		Deviance: 303 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/Cɔ̃#/	0.242	80	0.00519
	/Cɔ̃C#/	0.170	20	
	/ɔ̃CV(C)#/	-0.412	33	
F2	Continuous variable	0.252	113	0.0173
Non-significant factor groups were Lexical frequency (p=0.0619) and Speaker sex (p=0.0911).				

Table 5.40. All Middle speakers: Results of mixed-effects regression for F1 in [ɔ̃].

Nasal Unit = [ɔ̃] Dependent variable = F2 N = 113 Grand mean = -0.73		Deviance: 244 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.0136	113	0.0136
Non-significant factor groups were Lexical frequency (0.213), Syllable type (0.507), and Speaker sex (0.719).				

Table 5.41. All Middle speakers: Results of mixed-effects regression for F2 in [ɔ̃].

Finally, we can examine the extent to which the back nasal vowels are distinguished on the basis of F1 and F2. The regression models for F1 in sequential and non-sequential nasal units are presented in Tables 5.42 and 5.43 respectively. In both models, ‘phoneme’ is returned as a highly significant predictor of F1: /ã/ is significantly lower than /ɔ̃/. This distinction does not differ significantly between male and female speakers.

Nasal Unit = [ãN 5N] Dependent variable = F1 N = 588 Grand mean = 0.17		Deviance: 1555 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.591	272	6.74e-27
	/5/	-0.519	316	
Non-significant factor groups were Speaker sex (p=0.364) and Phoneme*Sex (p=0.789).				

Table 5.42. All Middle speakers: Results of mixed-effects regression for F1 in [ãN ãN].

Nasal Unit = [ã ̃]		Deviance: 821		
Dependent variable = F1		Degrees of freedom: 7		
N = 299				
Grand mean = -0.02				
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.411	166	1.74e-10
	/̃/	-0.411	133	
Non-significant factor groups were Speaker sex (p=0.742) and Phoneme*Sex (p=0.238).				

Table 5.43. All Middle speakers: Results of mixed-effects regression for F1 in [ã ã].

The analyses for F2 in sequential and non-sequential units are presented in Tables 5.44 and 5.45. In both cases, ‘phoneme’ is returned as a highly significant predictor of F2: /ã/ is significantly further forward in the vowel space than /õ/.

Nasal Unit = [ãN ãN] Dependent variable = F2 N = 433 Grand mean = -0.601		Deviance: 965 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.252	272	6.02e-17
	/õ/	-0.252	316	
Non-significant factor groups were Speaker sex (p=0.365) and Phoneme*Sex (p=0.351).				

Table 5.44. All Middle speakers: Results of mixed-effects regression for F2 in [ãN ãN].

Nasal Unit = [ã ẽ]		Deviance: 566		
Dependent variable = F2		Degrees of freedom: 7		
N = 299				
Grand mean = -0.555				
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.158	166	2.32e-05
	/ẽ/	-0.158	133	
Non-significant factor groups were Speaker sex (p=0.909) and Phoneme*Sex (p=0.894).				

Table 5.45. All Middle speakers: Results of mixed-effects regression for F2 in [ã ẽ].

5.2.2.2 LIP-ROUNDING AND F3

This section examines the use of F3 to distinguish between the vocalic elements of /ẽ/-/œ/ and /ã/-/õ/ in sequential and non-sequential nasal units.

Figure 5.17 presents mean F3 values and standard deviations for sequential nasal units and for individual male speakers. F3 values are similar for all nasal vowels and none of the male speakers make a phonetic distinction between [ẽN] and [œN] or between [ãN] and [õN] on the basis of F3.

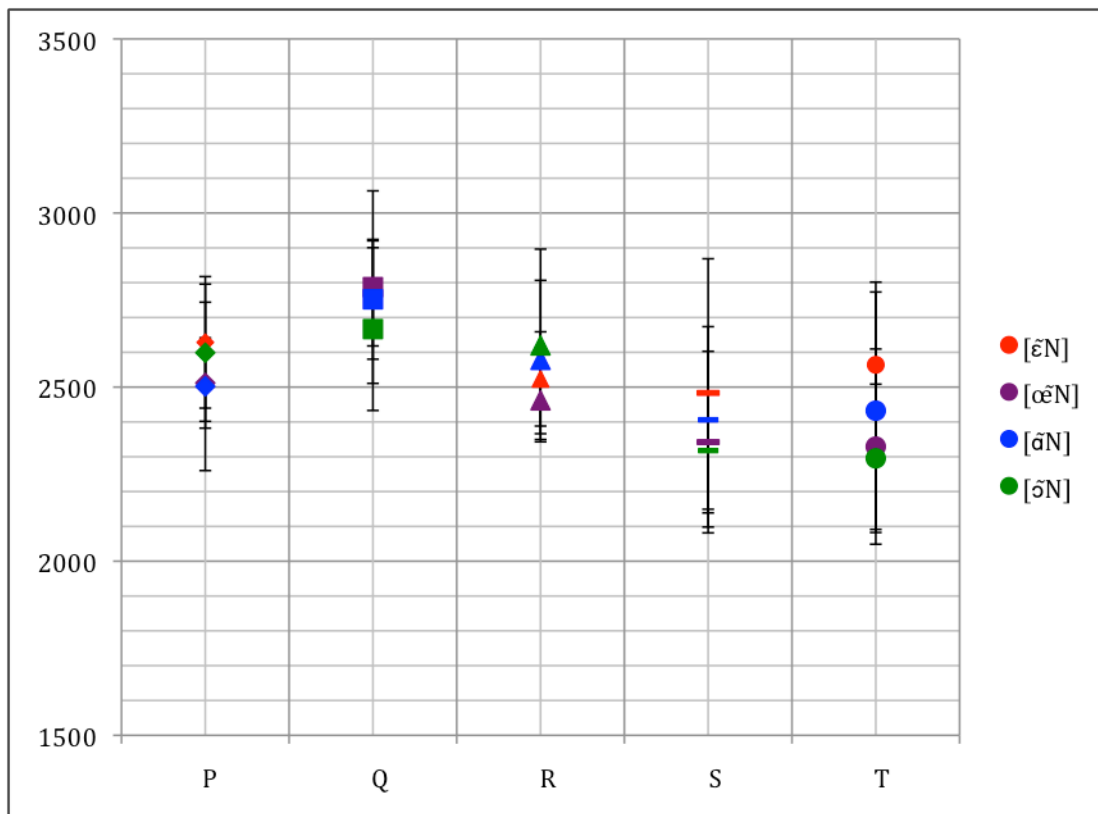


Figure 5.17. Middle Male Speakers: Mean F3 values and standard deviations for nasal vowels in sequential nasal units.

Figure 5.18 presents the same data for non-sequential nasal units considering individual male speakers. Once again, the F3 values observed are strikingly similar across nasal vowels and no speaker appears to distinguish between the front nasal vowels or between the back nasal vowels on the basis of F3.

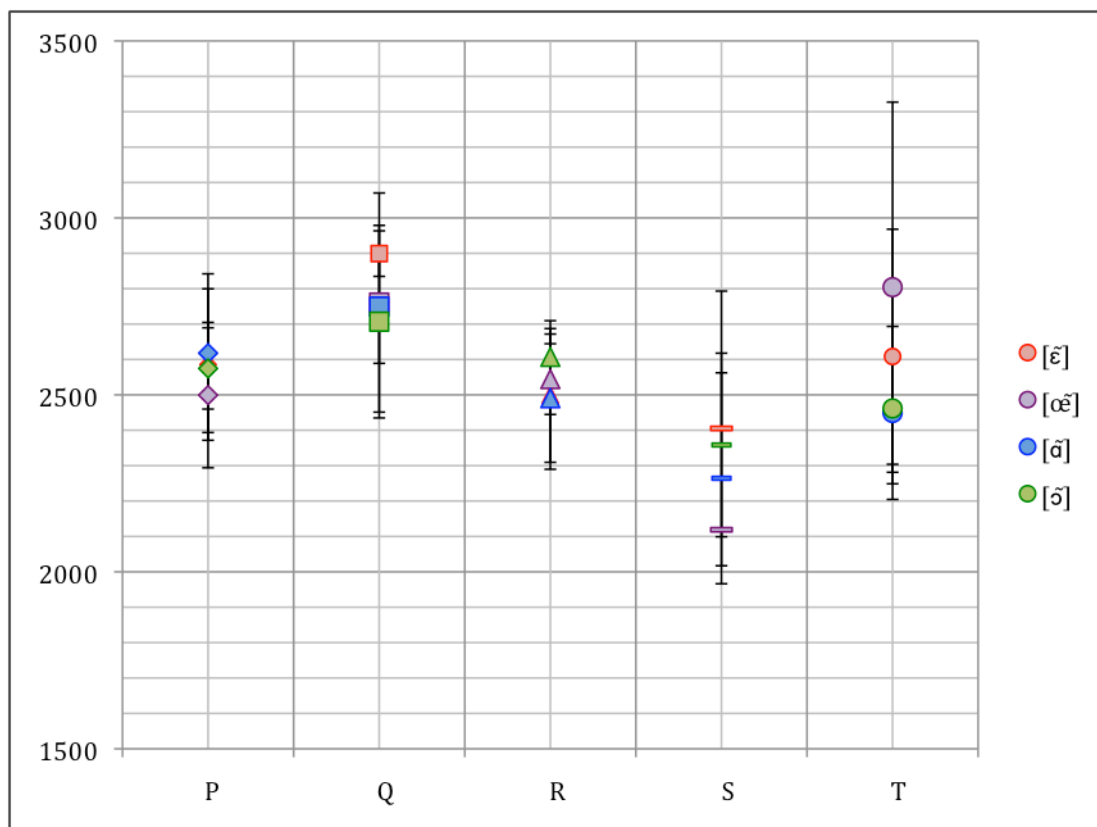


Figure 5.18. Middle Male Speakers: Mean F3 values and standard deviations for nasal vowels in non-sequential nasal units.

Figure 5.19 presents F3 data for individual female speakers for nasal vowels in sequential units. For the front mid-vowels, all speakers, except Speaker L, exhibit mean values for [ɛ̃N] that are higher than those of [œ̃N]. Only Speakers K and M exhibit separate F3 distributions for the front nasal vowels; Speakers N and O show minimal overlap between their distributions; Speaker L exhibits a high level of overlap. For the back nasal vowels, all speakers exhibit overlapping distributions for [ãN] and [õN] indicating that they do not utilise F3 to distinguish phonetically between these vowels.

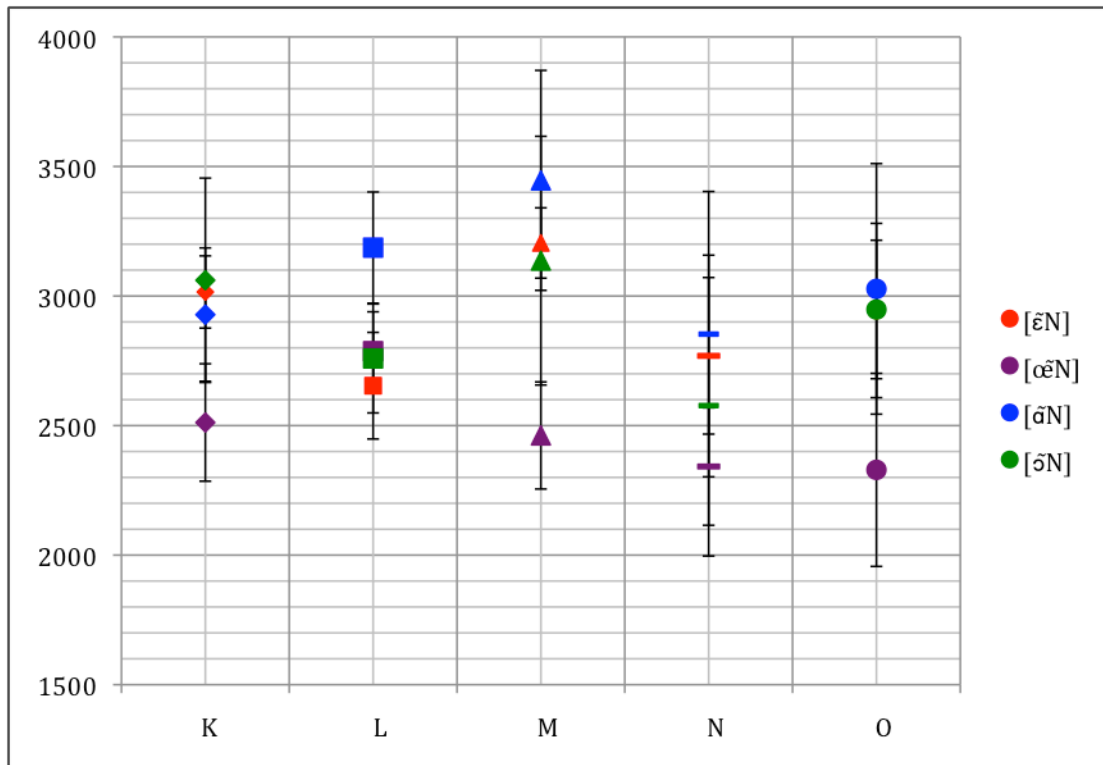


Figure 5.19. Middle Female Speakers: Mean F3 values and standard deviations for nasal vowels in sequential nasal units.

Finally, Figure 5.20 presents the same data in non-sequential nasal units. The F3 values for all nasal vowels are similar for individual speakers. No female speakers produce separate F2 distributions for [ɛ̃N] and [œ̃N] or for [ãN] and [ɔ̃N]. This indicates that female speakers do not distinguish between the front or between the back nasal vowels on the basis of F3 when they occur in non-sequential units.

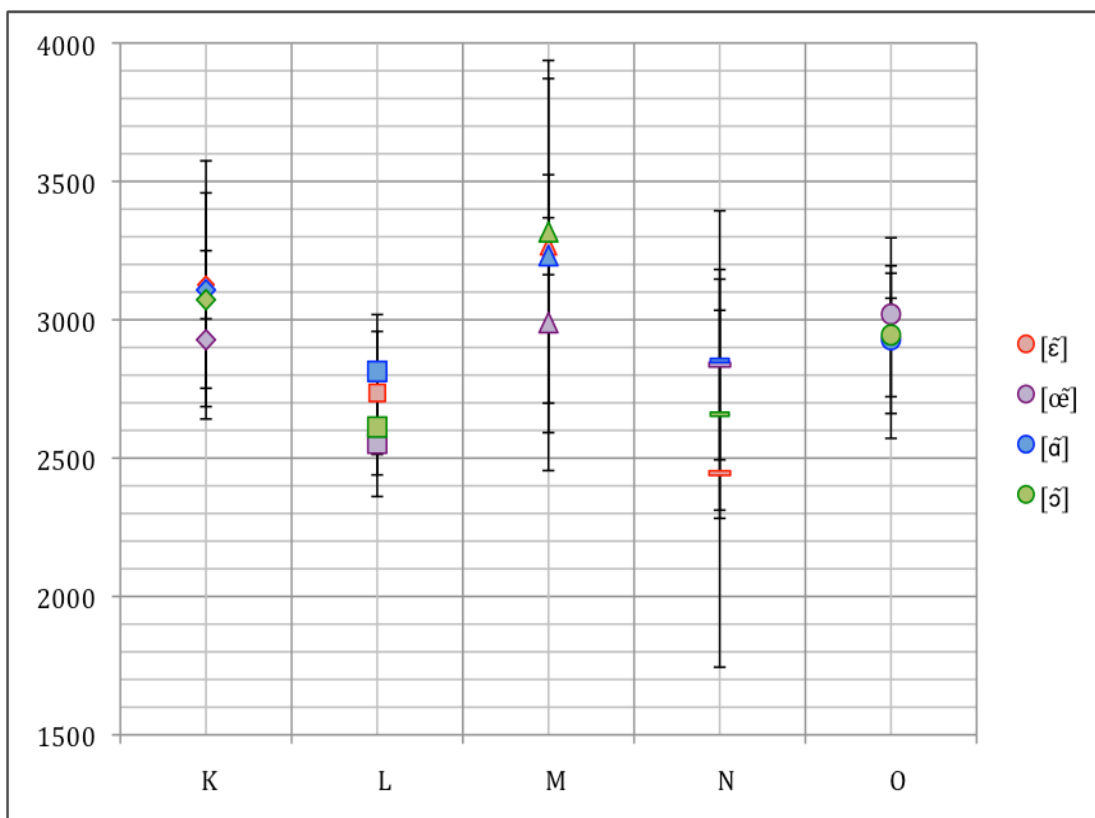


Figure 5.20. Middle Female Speakers: Mean F3 values and standard deviations for nasal vowels in non-sequential nasal units.

5.2.2.2.1 MODELLING LIP-ROUNDING AND F3

The regression models for F3 are presented for sequential and non-sequential front nasal vowels in Tables 5.46 and 5.47 respectively. In neither case is ‘phoneme’ returned as a significant predictor of the variation observed. This confirms that / $\tilde{\epsilon}$ / and / $\tilde{\text{o}}$ / are not distinguished on the basis of F3 but they were distinguished on the basis of F2 (see Tables 5.32 and 5.33).

Nasal Unit = [$\tilde{\epsilon}$ N $\tilde{\text{o}}$ N] Dependent variable = F3 N = 406 Grand mean = -0.034	Deviance: 1023 Degrees of freedom: 7
Non-significant factor groups were Phoneme (0.116), Speaker sex (0.833), and Phoneme*Sex (0.285).	

Table 5.46. All Middle speakers: Results of mixed-effects regression for F3 in [$\tilde{\epsilon}$ N $\tilde{\text{o}}$ N].

Nasal Unit = [ẽ œ]	Deviance: 323 Degrees of freedom: 7
Dependent variable = F3 N = 120 Grand mean = 0.04	
Non-significant factor groups were Phoneme (0.284), Speaker sex (0.129), and Phoneme*Sex (0.847).	

Table 5.47. All Middle speakers: Results of mixed-effects regression for F3 in [ẽ œ].

For the back nasal vowels, the regression models are presented in Tables 5.48 and 5.49 for sequential and non-sequential nasal units. When a consonant is present, the regression model for sequential units includes two fixed-effect factor groups as predictors: speaker sex ($p \leq 0.05$) and ‘phoneme’ ($p \leq 0.01$). The significant effect for ‘phoneme’ indicates that [õN] favours lower F3 values than [ãN], consistent with the hypothesis that lip-rounding of /õ/ distinguishes it from /ã/. Speaker sex was also returned as a significant predictor of F3. Separate analyses for male and female speakers revealed that ‘phoneme’ was only a significant predictor for female speakers ($p = 0.00638$) while this was not true for male speakers ($p = 0.303$). The regression model for non-sequential units in Table 5.49 includes no significant predictors for F3 in nasal units when a consonantal coda is absent. Thus only female speakers distinguish F3 between /ã/ and /õ/, and only in sequential units.

Nasal Unit = [ãN õN]		Deviance: 1731		
Dependent variable = F3		Degrees of freedom: 7		
N = 588				
Grand mean = 0.011				
Factor Group	Factor	Coeff.	N	P-value
Sex	Female	0.107	277	0.034
	Male	-0.107	311	
Phoneme	/ã/	0.13	272	0.00801
	/õ/	-0.13	316	
Non-significant factor groups were Phoneme*Sex (0.144).				

Table 5.48. All Middle speakers: Results of mixed-effects regression for F3 in [ãN õN].

Nasal Unit = [ã ɔ] Dependent variable = F3 N = 299 Grand mean = 0.009	Deviance: 861 Degrees of freedom: 7
Non-significant factor groups were Phoneme (0.567), Speaker sex (0.779), and Phoneme*Sex (0.56).	

Table 5.49. All Middle speakers: Results of mixed-effects regression for F3 in [ã ɔ].

5.2.2.3 NASAL CONSONANT CODAS

Table 5.50 presents the frequency distribution for nasal consonant presence versus absence. Nasal consonant presence is the majority variant, with similar distributions across the phonemes.

Nasal Unit	Consonant presence/absence		
	N	% Sequential	% Non-Sequential
/ẽ/	371	78	22
/œ̃/	155	75	25
/ã/	438	62	38
/ɔ̃/	449	70	30

Table 5.50. Middle speakers: The relationship between nasal consonant presence/absence and nasal vowel.

Table 5.51 illustrates the relationship between syllable type and the frequency distribution of consonant presence both between and across nasal vowels. As was the case for older speakers, there are no tokens of /œ̃/ in final closed syllables (/C̃VC#/) and only two tokens in medial open syllables (/̃VCV(C)#/). It is thus difficult to compare consonant absence/presence across syllable type for this variable. In final open syllables (/C̃V#/), where it occurs regularly, we can, however, observe that

75% of nasal units contain a nasal consonant coda. The other nasal units occur regularly in all syllabic contexts. With the exception of /ɔ̃/ in final open syllables (/Cɔ̃#/), consonant presence is the majority variant across variables and syllabic contexts. In final closed syllables, /ɛ̃/ and /ɔ̃/ (88% and 86%) appear to favour consonant presence much more than /ɑ̃/ (66%). In final open syllables, consonantal codas are less frequent, occurring 66% of the time in /ɛ̃/, 51% in /ɑ̃/ and 49% in /ɔ̃/. These findings indicate that while consonant codas are favoured in general, they are especially favoured by final closed syllables and by certain nasal units in each context. In the medial open syllabic context, rates of consonant presence are comparably high across the nasal units. The overall pattern, considering all nasal vowels together, suggests that final closed and medial open syllables favour consonant presence while final open syllables favour fewer consonant codas in the nasal unit.

Nasal Unit	N	Consonant presence/absence		
		Syllable Type	% Sequential	% Non-Sequential
/ɛ̃/	93	/C̃ṽC#/	88	12
	136	/ṽCV(C)#/	83	17
	142	/C̃ṽ#/	66	34
/œ̃/	0	/C̃ṽC#/	ND	ND
	2	/ṽCV(C)#/	100	0
	153	/C̃ṽ#/	75	25
/ã/	144	/C̃ṽC#/	66	34
	140	/ṽCV(C)#/	70	30
	154	/C̃ṽ#/	51	49
/õ/	143	/C̃ṽC#/	86	14
	150	/ṽCV(C)#/	78	22
	156	/C̃ṽ#/	49	51
Total	380	/C̃ṽC#/	79	21
	428	/ṽCV(C)#/	77	33
	605	/C̃ṽ#/	60	40

Table 5.51. Middle speakers: The relationship between nasal consonant presence/absence and syllable type in sequential nasal units.

The logistic regression model for consonant absence/presence is presented in Table 5.52. This model includes ‘speaker’ and ‘word’ as random effects and treats consonant presence as the response variable. Both ‘phoneme’ and syllable type are returned by the analysis as significant predictors. The front vowels, /ɛ̃/ and /œ̃/, are shown to favour consonant presence while the back nasal vowels, /ã/ and /õ/, disfavour it, particularly /ã/. The expected pattern of syllabic conditioning is

returned as highly significant: medial open and final closed syllables favour sequential nasal units; final open syllables favour non-sequential units.

Nasal Unit = /ẽ œ ã õ/ Dependent variable = Consonant absence/presence Response variable = Consonant presence N = 1413 Grand mean = 0.703		Deviance: 1445 Degrees of freedom: 10		
Factor Group	Factor	Log Odds	N	P-value
Syllable type	/ǃCV(C)#/	0.624	428	9.79e-08
	/CǃC#/	0.425	380	
	/Cǃ#/	-1.048	605	
Phoneme	/œ/	0.763	155	0.00998
	/ẽ/	0.316	371	
	/õ/	-0.346	449	
	/ã/	-0.733	438	
Non-significant factor groups were Lexical frequency (p=0.281) and Speaker sex (p=0.361).				

Table 5.52. Middle Speakers: Results of mixed-effects logistic regression for consonant absence/presence.

5.2.2.4. SUMMARY OF THE NASAL VOWELS FOR THE MIDDLE GENERATION

The phonological contrast between the front nasal vowels was maintained in the same way in sequential and non-sequential nasal units: middle generation speakers distinguished between /ẽ/ and /œ/ on the basis of F2, but not F1 or F3. For the back nasal vowels, /ã/ and /õ/ were distinguished significantly on the basis of both F1 and F2: /ã/ was significantly lower and more central than /õ/ in both sequential and non-sequential units. For F3, no significant distinction was made between the back nasal vowels in non-sequential nasal units or by male speakers in

sequential nasal units. Only female speakers made a phonetic distinction between /ã/ and /õ/ in sequential units, with /õ/ favouring lower F3 values.

Various constraints were found to govern the variation present in the nasal vowel system of the middle generation, in both sequential and non-sequential nasal units. For /ẽ/, final syllables were shown to favour higher F1 values than medial syllables in sequential units. For non-sequential /ẽ/, both F1 and F2 were affected by syllabic context: lower, centralised vowels in final open syllables; higher, fronter vowels in final closed syllables; intermediate height centralised vowels in medial open syllables. For /œ/, there was a significant positive correlation between F1 and F2 in sequential units: lower vowels were also fronter. This correlation was not significant in non-sequential units. The back nasal vowels, /ã/ and /õ/, showed similar effects of syllabic context on F1: lower vowels in final closed syllables; higher vowels in medial syllables; intermediate vowels in final open syllables. In non-sequential units, on the other hand, the general pattern for /ã/ and /õ/ was lower vowels in final syllables and relatively higher vowels in medial syllables. Both /ã/ and /õ/ also exhibited significant positive correlations between F1 and F2 in both sequential and non-sequential nasal units. Finally, lexical frequency effects were established for both /ẽ/ and /ã/, but not for the other vowels. In the case of /ẽ/, high frequency words were shown to favour higher vowels. For /ã/, high frequency words favoured (fronter) vowels while low frequency words favoured more back variants.

Finally, the presence of a nasal consonant coda was shown to be conditioned by syllable type and by the phonemic identity of the nasal unit. While all nasal vowels favoured sequential units as the majority variant, they did so to different extents: /œ̃/ favoured consonant presence the most, followed by /ẽ̃/, and then /õ̃/ and /ã̃/. The frequency of consonant presence was also significantly influenced by syllable type: medial open and final closed syllables favoured consonant presence; sequential nasal units were least frequent in final open syllables.

5.2.3 YOUNG GENERATION

This section presents the results for the French nasal vowels in the young generation. Table 5.53 provides the token counts for male and female speakers, for vowels in sequential and non-sequential nasal units. In general, there is a tendency for nasal consonants to be present in the nasal unit but this varies across vowels at the speaker level.

Sex	Speaker	/ẽ̃/		/œ̃/		/ã̃/		/õ̃/	
		[ẽ̃N]	[ẽ̃]	[œ̃N]	[œ̃]	[ã̃N]	[ã̃]	[õ̃N]	[õ̃]
F	U	11	22	6	10	15	29	25	20
	V	27	12	11	4	28	15	36	7
	W	27	7	11	4	22	21	26	19
	X	19	12	13	3	20	23	23	13
	Y	9	12	15	2	26	19	33	4
M	Z	26	5	11	3	33	10	31	11
	@	23	6	11	4	34	10	29	7
	\$	15	6	12	3	29	16	28	6
	£	14	21	3	14	12	32	23	20
	€	16	17	5	10	15	33	22	18
Total		187	120	98	57	234	208	276	125

Table 5.53. Token counts for French nasal vowels by ‘Young’ speakers (F = female; M = male).

Figure 5.21 presents the F1 and F2 values produced in sequential nasal units by young male speakers. There is overlap evident on all dimensions when all speakers are considered together. The mean F1 and F2 values and standard deviations are presented in Figure 5.22. For all young male speakers, the front and back nasal vowels are separate, with the exception of Speaker @, for whom there is a small amount of overlap between [œ̃N] and [ã̃N]. All speakers exhibit overlapping distributions for [œ̃N] and [ẽ̃N] but the degree of separation varies between speakers. There is also a general tendency for mean F2 values of [œ̃N] to be lower than those for [ẽ̃N]. In the back of the vowel space, all speakers show mean separation between [ã̃] and [õ̃] with the former lower and centralised relative to the latter. Speakers @, \$ and £ produced distributions for the back nasal vowels that are completely separate while Speakers Z and € exhibit distributional overlap between the vowels: the amount of overlap present is greater for Speaker €.

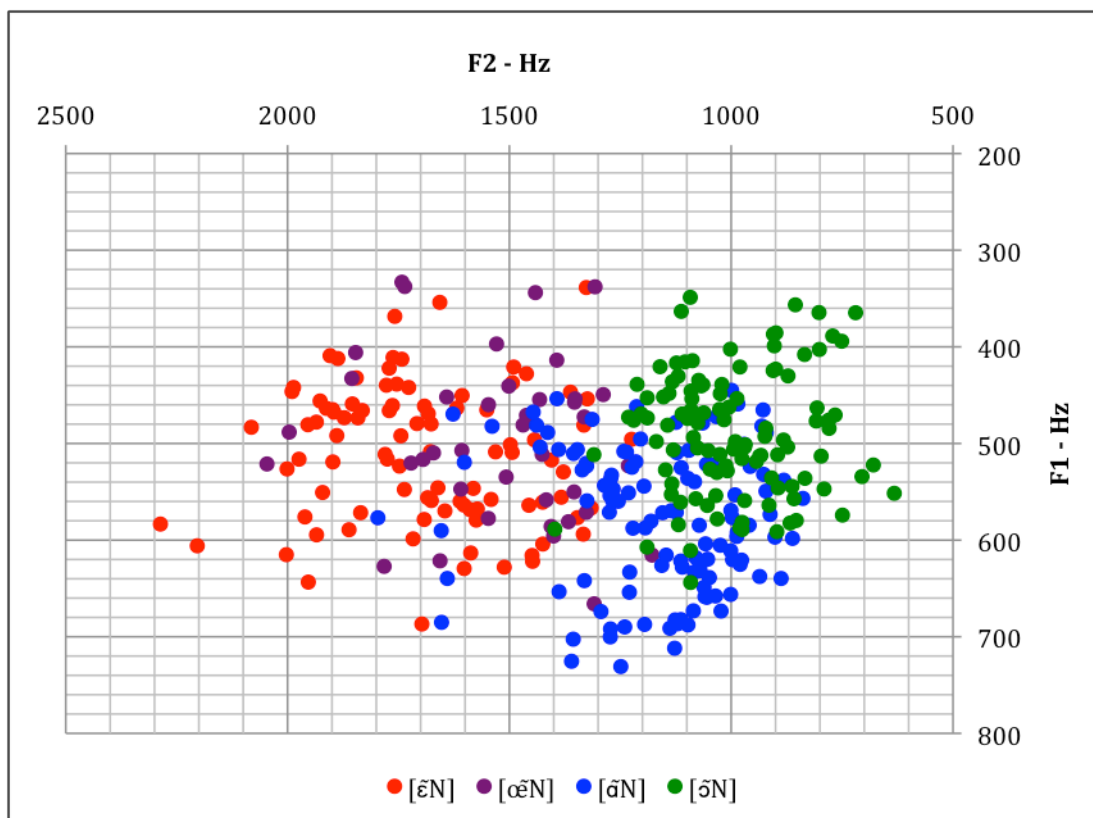


Figure 5.21. Young Male Speakers: F1 and F2 values for nasal vowels in sequential ($\tilde{v}N$) nasal units.

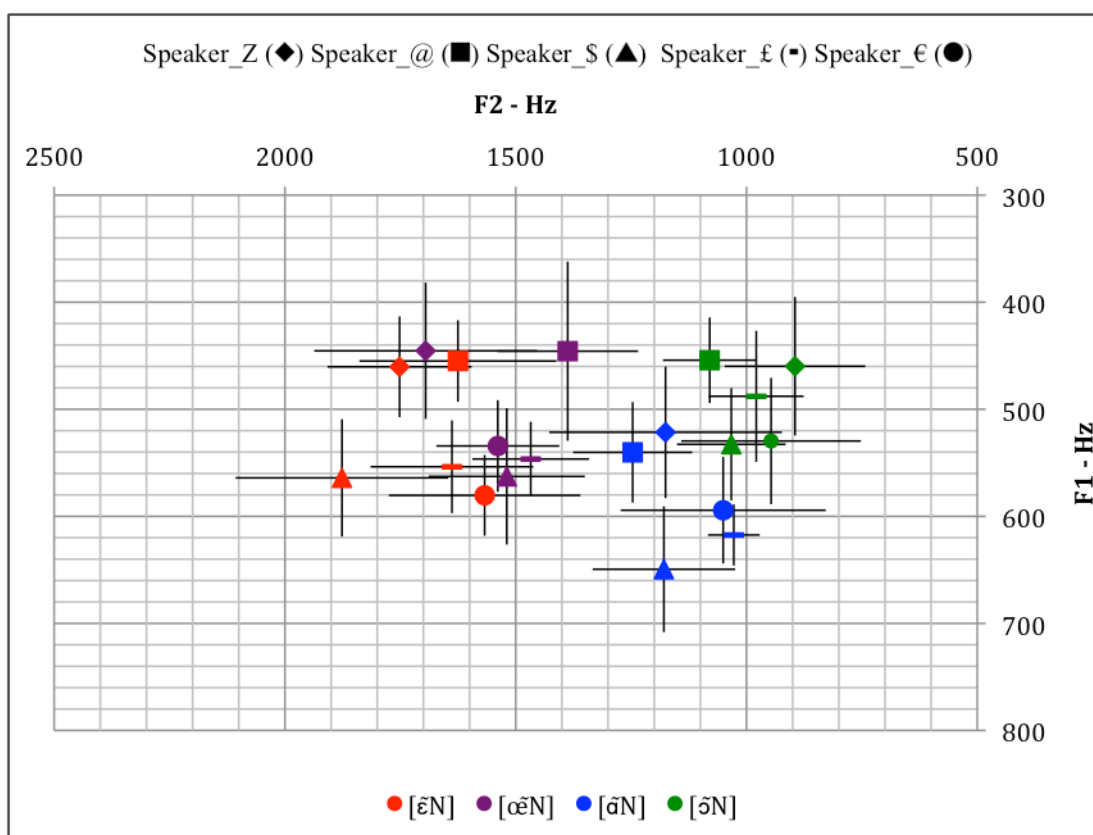


Figure 5.22. Young Male Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in sequential ($\tilde{v}N$) nasal units.

F1 and F2 values for nasal vowels in non-sequential nasal units are presented in Figure 5.23 for young male speakers. There is a high degree of overlap evident between the front nasal vowels and between the back nasal vowels. Figure 5.24 presents the mean F1 and F2 values and standard deviations for each male speaker. In non-sequential nasal units, all speakers exhibit separation between the front and back nasal vowels with the exception of Speaker @ who produces overlapping distributions for [œ̃] and [ã̃]. Only Speaker @ shows complete separation between the front nasal vowels, [ē̃] and [œ̃], with all other speakers producing overlapping distributions. For the back nasal vowels, Speakers Z, @ and \$ show distributions that are completely separate. Speaker € has a small amount of distributional overlap between the back vowels while Speaker £ exhibits substantial overlap between [ã̃] and [ɔ̃] on both dimensions.

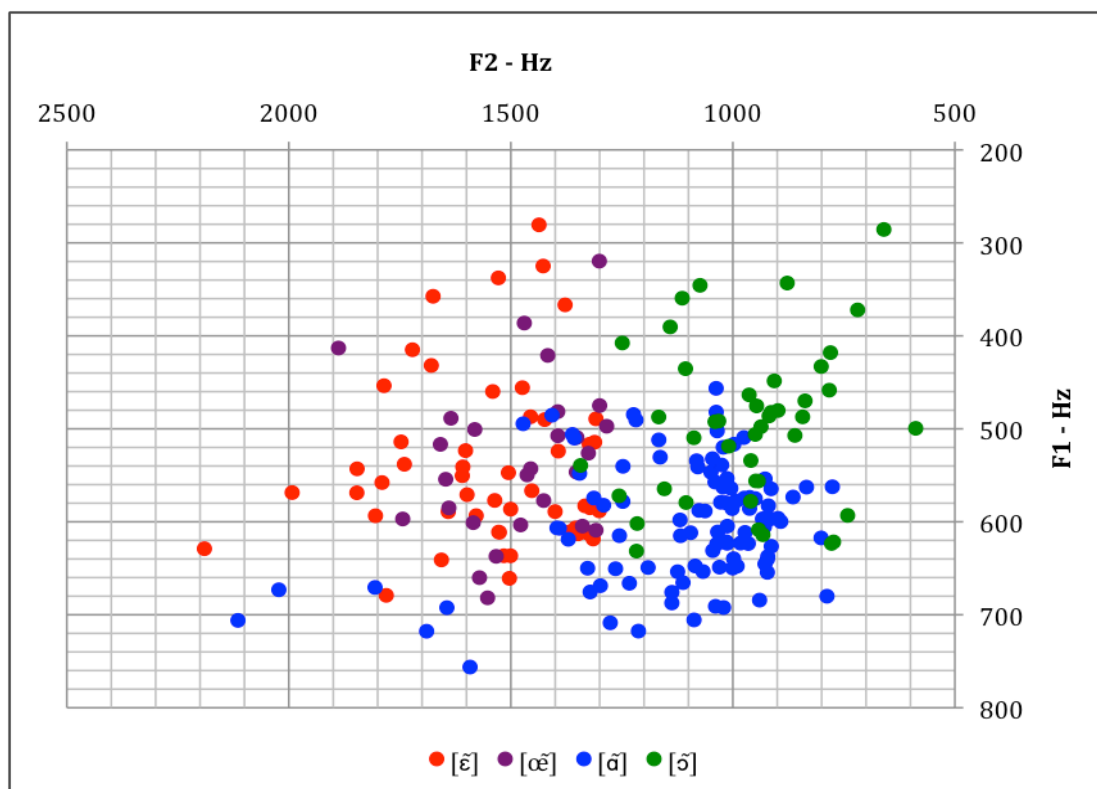


Figure 5.23. Young Male Speakers: F1 and F2 values for nasal vowels in non-sequential (ṽ) nasal units.

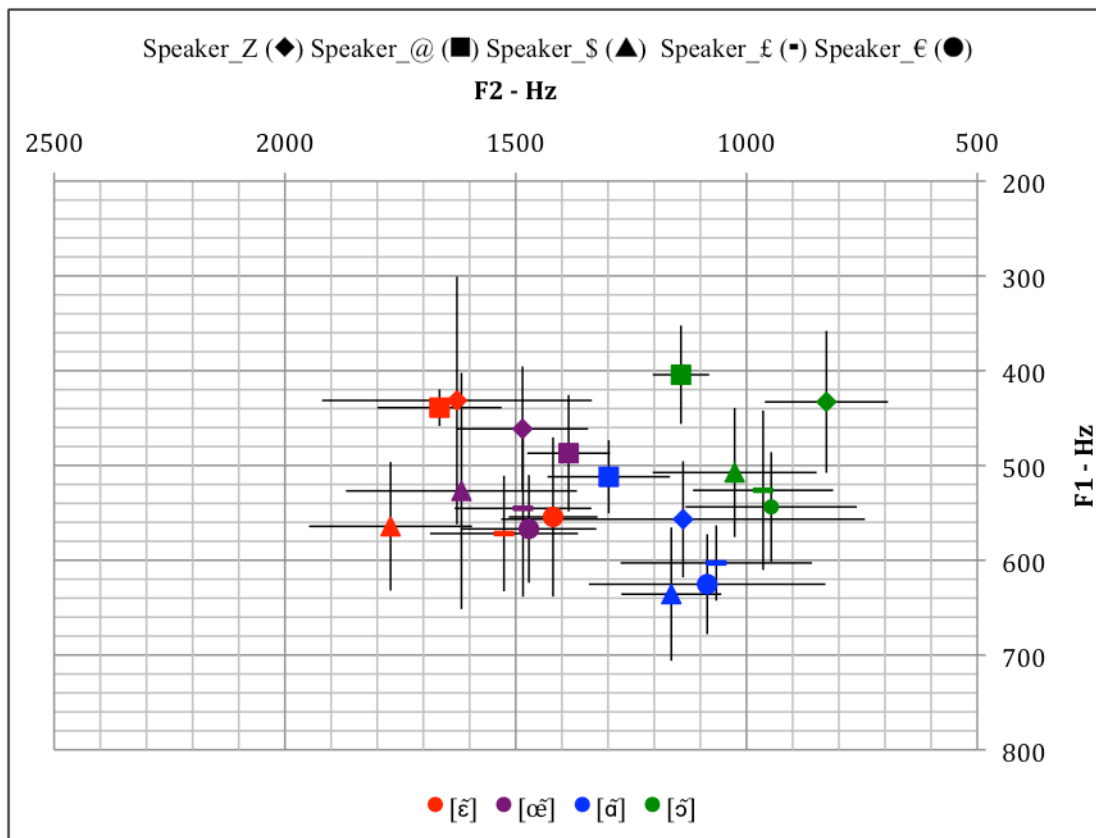


Figure 5.24. Young Male Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in non-sequential ($\tilde{v}$) nasal units.

The F1 and F2 values for the nasal vowels produced by young female speakers are plotted in Figure 5.25. The general position of the vowels relative to each other is as expected but some overlap is evident in the central area of the vowel space between all vowels.

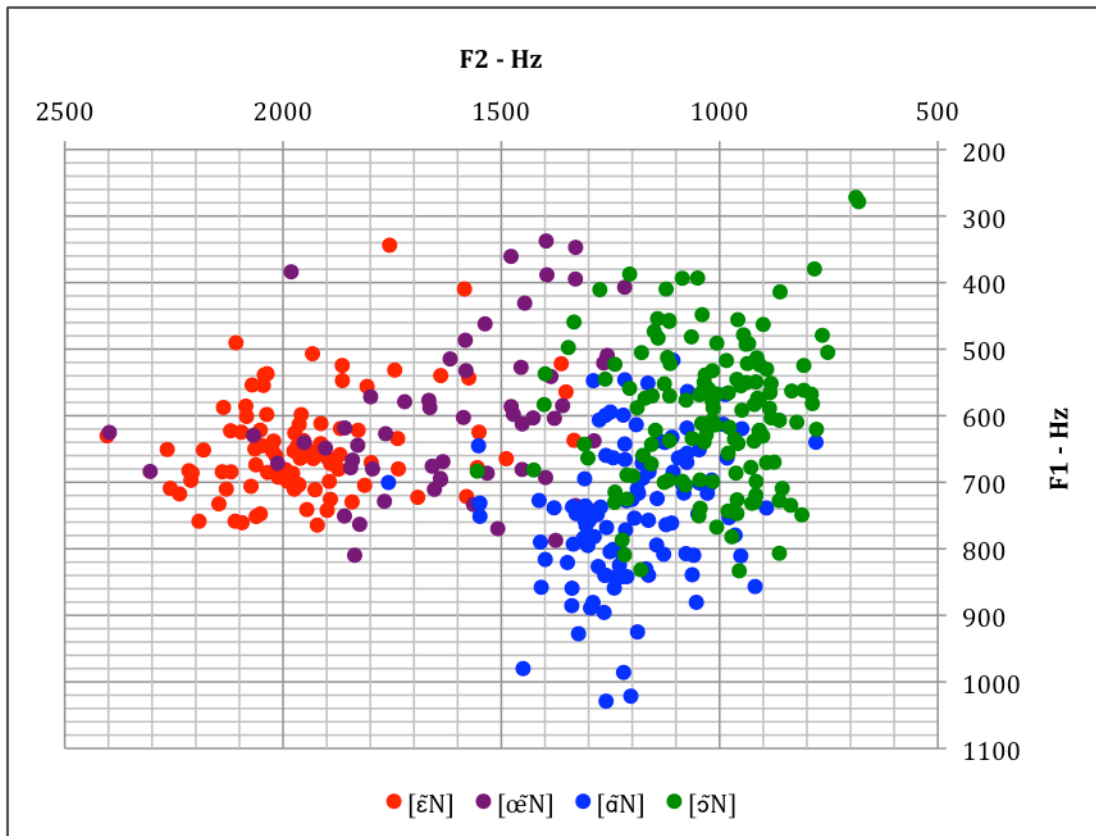


Figure 5.25. Young Female Speakers: F1 and F2 values for nasal vowels in sequential ($\tilde{v}$ N) nasal units.

The mean F1 and F2 values and standard deviations for the nasal vowels produced by individual young female speakers in sequential nasal units are presented in Figure 5.26. All female speakers exhibit separation between the front and back nasal vowels with the marginal exception of Speaker U. Speaker X exhibits distributions for $[\tilde{\epsilon}N]$ and $[\tilde{\text{o}}\tilde{\epsilon}N]$ that are almost completely overlapping, but all of the other speakers separate the front vowels, with a small degree of overlap for Speakers U and V. In the back of the vowel space, all speakers, with the exception of Speaker Y, show completely separate distributions for $[\tilde{\text{a}}N]$ and $[\tilde{\text{o}}N]$, with a tendency for the former to be lower and more centralised than the latter.

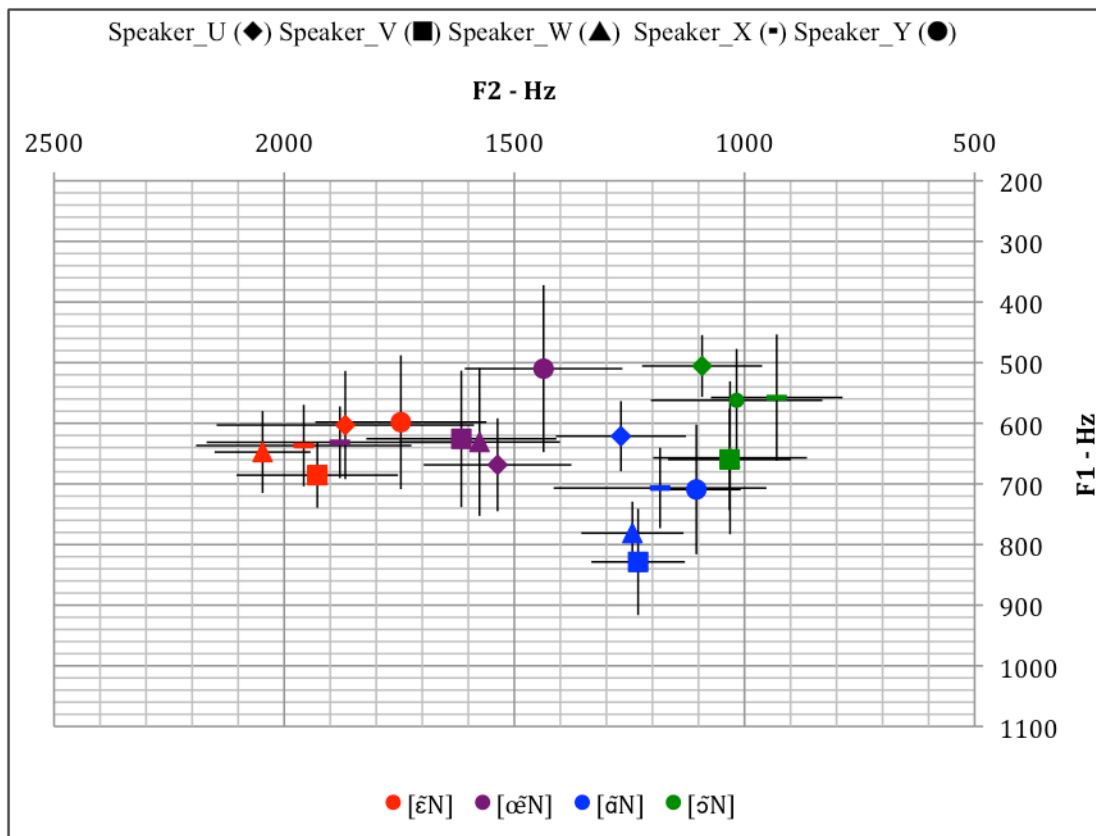


Figure 5.26. Young Female Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in sequential (VN) nasal units.

Figure 5.27 presents the token for nasal vowels produced by female speakers in non-sequential nasal units. The relative positions of the vowels are generally as expected some with overlap evident between all vowels in the centre of the vowel space.

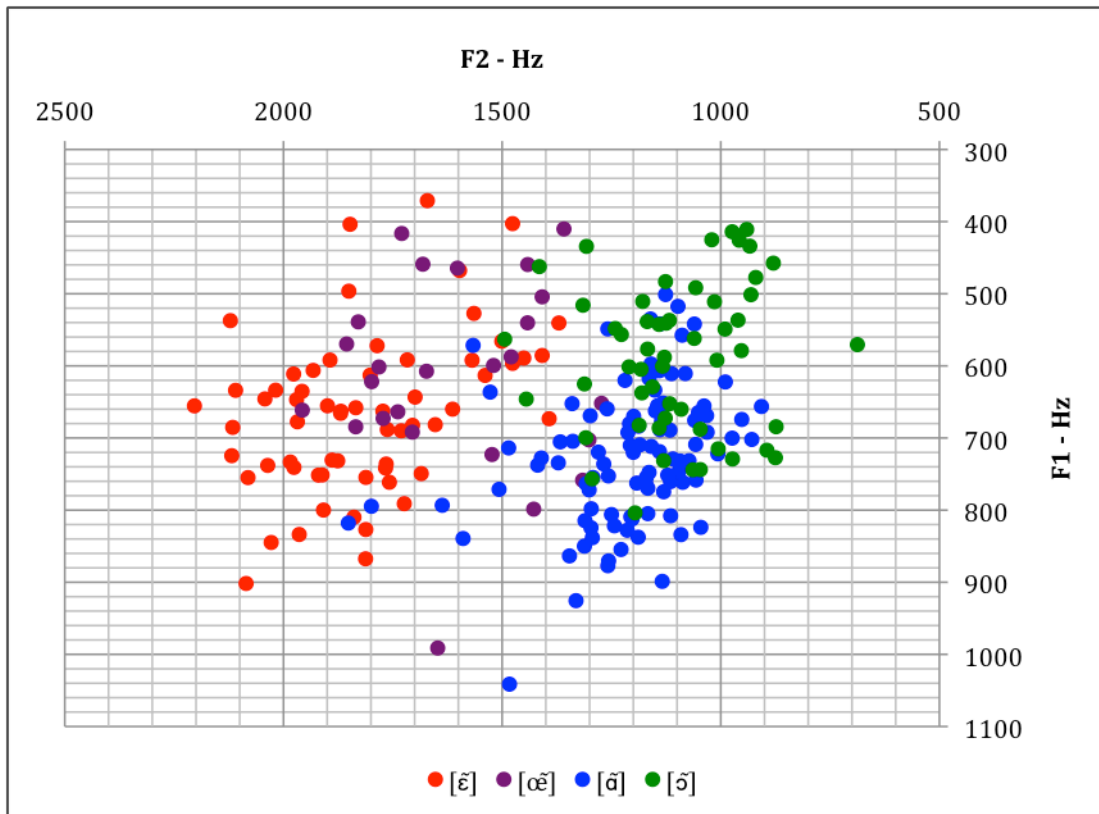


Figure 5.27. Young Female Speakers: F1 and F2 values for nasal vowels in non-sequential ($\tilde{v}$) nasal units.

The mean F1 and F2 values and standard deviations for individual female speakers are plotted for all nasal vowels in Figure 5.28. The front and back vowels are separate for all speakers. For Speakers V and Y, the front nasal vowels, [ẽ] and [œ̃], are completely separate while the other speakers exhibit distributional overlap between them, though this is minimal for Speaker W. There is a tendency for the mean values of [ã] to be lower and centralised relative to [õ]. Only Speakers V and W show complete separation between the back vowels: other speakers exhibit varying degrees of overlap on both dimensions.

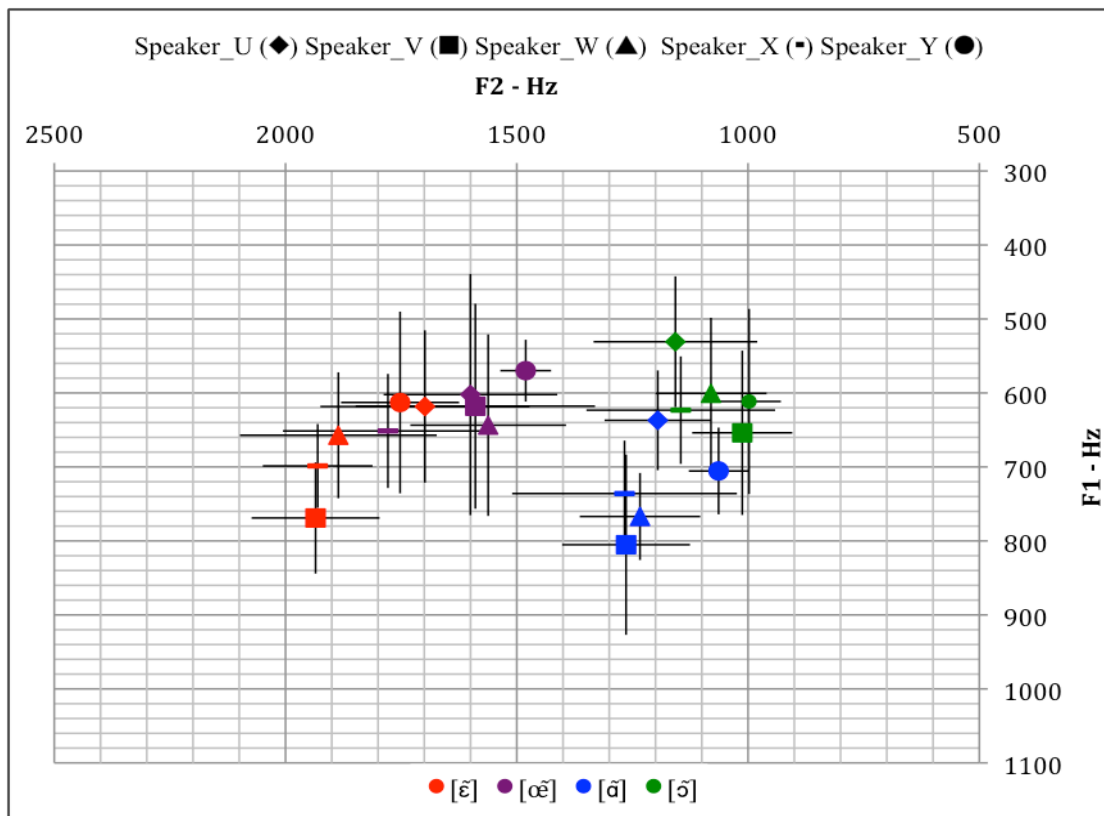


Figure 5.28. Young Female Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in non-sequential (ñ) nasal units.

5.2.3.1 MODELLING SEQUENTIAL AND NON-SEQUENTIAL NASAL UNITS

This section presents the statistical models for the nasal vowels comparing sequential and non-sequential nasal units. Beginning with /ẽ/, the mixed-effects regression models for F1 and F2 in sequential nasal units, presented in Tables 5.54 and 5.55 respectively, include no significant predictors of the variation observed. This means that there is no significant difference between [ẽN] in different syllabic contexts or between male and female speakers.

Nasal Unit = [ɛ̃N] Dependent variable = F1 N = 187 Grand mean = -0.22	Deviance: 373 Degrees of freedom: 9
Non-significant factor groups were Syllable type (p=0.136), Lexical frequency (p=0.579), Speaker sex (p=0.651), and F2 (p=0.932).	

Table 5.54. All Young speakers: Results of mixed-effects regression for F1 in [ɛ̃N].

Nasal Unit = [ɛ̃N] Dependent variable = F2 N = 187 Grand mean = 1.214	Deviance: 350 Degrees of freedom: 9
Non-significant factor groups were Lexical frequency (p=0.0639), Syllable type (p=0.133), Speaker sex (p=0.55), and F1 (p=0.575).	

Table 5.55. All Young speakers: Results of mixed-effects regression for F2 in [ɛ̃N].

In non-sequential nasal units, significant predictors are included in the F1 and F2 models. Table 5.56 presents the regression model for F1 which contains three significant fixed-effect factor groups: syllable type ($p \leq 0.01$); F2 ($p \leq 0.01$); lexical frequency ($p \leq 0.05$). The effect of syllable type shows that final syllables favour high F1 values (lower vowels) while medial syllables favour low F1 values (higher vowels). The magnitude of these effects is large and the effect is very strong. There is a significant negative correlation between F1 and lexical frequency: higher frequency lexical items contain [ɛ̃] vowels with significantly lower F1 values (higher vowels). There is also a highly significant positive correlation between the values of F1 and F2: lower vowels are also fronter vowels. The regression model for F2 in Table 5.57 shows this F1/F2 correlation to be the only significant predictor, confirming the relationship between the two formant frequencies.

Nasal Unit = [ɛ̃] Dependent variable = F1 N = 120 Grand mean = 0.073		Deviance: 310 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C $\tilde{v}$ C#/	0.328	10	0.00127
	/C $\tilde{v}$ #/	0.222	78	
	/ $\tilde{v}$ CV(C)#/	-0.550	32	
F2	Continuous variable	0.373	120	0.00409
Lexical frequency	Continuous (log-transformed)	-0.28	120	0.0379
Non-significant factor groups were Speaker sex (p=0.173).				

Table 5.56. All Young speakers: Results of mixed-effects regression for F1 in [ɛ̃].

Nasal Unit = [ɛ̃] Dependent variable = F2 N = 120 Grand mean = 0.897		Deviance: 229 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.194	120	0.00241
Non-significant factor groups were Syllable type (p=0.168), Lexical frequency (p=0.324), and Speaker sex (p=0.457).				

Table 5.57. All Young speakers: Results of mixed-effects regression for F2 in [ɛ̃].

No significant predictors were returned for the F1 and F2 values of /œ̃/ in sequential nasal units, which are presented in Tables 5.58 and 5.59. In non-sequential units, on the other hand, the regression model for F1 (Table 5.60) contains two significant fixed effect predictors: syllable type ($p \leq 0.05$) and lexical frequency ($p \leq 0.05$). Final open syllables favour high F1 values (lower vowels) while medial open syllables favour low F1 values (higher vowels). The regression coefficient for medial open syllables is, however, based only on two tokens (due to the infrequency of /œ̃/ in this syllabic context) and is therefore meaningless. There is also a

significant negative correlation between F1 and lexical frequency: high frequency lexical items, such as ‘un’, favour low F1 values (or higher vowels) relative to lower frequency items, such as ‘aucun’. The regression model for F2 in non-sequential nasal units contains no significant predictors (Table 5.61).

Nasal Unit = [œN] Dependent variable = F1 N = 98 Grand mean = -0.435	Deviance: 274 Degrees of freedom: 8
Non-significant factor groups were Lexical frequency (p=0.404), F2 (p=0.515), Speaker sex (p=0.693), and Syllable type (p=0.854).	

Table 5.58. All Young speakers: Results of mixed-effects regression for F1 in [œN].

Nasal Unit = [œN] Dependent variable = F2 N = 98 Grand mean = 0.551	Deviance: 169 Degrees of freedom: 8
Non-significant factor groups were F1 (p=0.63), Syllable type (p=0.655), Lexical frequency (p=0.79), and Speaker sex (p=0.907).	

Table 5.59. All Young speakers: Results of mixed-effects regression for F2 in [œN].

Nasal Unit = [œ]		Deviance: 157 Degrees of freedom: 8		
Dependent variable = F1 N = 57 Grand mean = -0.255				
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C $\tilde{v}$ #/	0.973	55	0.0316
	/ $\tilde{v}$ CV(C)#/	-0.973	2	
Lexical frequency	Continuous (log-transformed)	-0.431	57	0.0379
Non-significant factor groups were F2 (p=0.25) and Speaker sex (p=0.665).				

Table 5.60. All Young speakers: Results of mixed-effects regression for F1 in [œ].

Nasal Unit = [œ]	Deviance: 87
Dependent variable = F2	Degrees of freedom: 8
N = 57	
Grand mean = 0.503	
Non-significant factor groups were Syllable type (p=0.135), F1 (p=0.214), Lexical frequency (p=0.562), and Speaker sex (p=0.702).	

Table 5.61. All Young speakers: Results of mixed-effects regression for F2 in [œ].

The phonetic distinction between /ẽ/ and /œ/ in sequential units is modelled statistically and presented in Tables 5.62 and 5.63 for F1 and F2 respectively. The regression model for F1 contains no significant predictors: there is no significant phonetic distinction made between the front nasal vowels on the basis of vowel height. In the F2 model, ‘phoneme’ is returned by the analysis as a significant predictor: /ẽ/ and /œ/ are distinguished phonetically by young speakers on the F2 dimension.

Nasal Unit = [ẽN œN]	Deviance: 671
Dependent variable = F1	Degrees of freedom: 7
N = 285	
Grand mean = -0.294	
Non-significant factor groups were Phoneme (p=0.386), Speaker sex (p=0.664), and Phoneme*Sex (p=0.595).	

Table 5.62. All Young speakers: Results of mixed-effects regression for F1 in [ẽN œN].

Nasal Unit = [ẽN œN] Dependent variable = F2 N = 285 Grand mean = 0.986		Deviance: 540 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ẽ/	0.225	187	0.0433
	/œ/	-0.225	98	
Non-significant factor groups were Speaker sex (p=0.654) and Phoneme*Sex (p=0.514).				

Table 5.63. All Young speakers: Results of mixed-effects regression for F2 in [ẽN œN].

When a nasal coda is not present, the same pattern is evident: there is no significant vowel height difference made between the front nasal vowels (see Table 5.64) but

/ɛ̃/ and /œ̃/ are distinguished phonetically on the basis of F2 (see Table 5.65). The statistical effect of this phonetic distinction is stronger in sequential than in non-sequential units but its magnitude is less. This implies that the distinction is maintained more consistently in non-sequential units but the degree of phonetic separation between the vowels is smaller.

Nasal Unit = [ɛ̃ œ̃] Dependent variable = F1 N = 177 Grand mean = -0.033	Deviance: 493 Degrees of freedom: 7
Non-significant factor groups were Phoneme (p=0.0993), Speaker sex (p=0.139), and Phoneme*Sex (p=0.196).	

Table 5.64. All Young speakers: Results of mixed-effects regression for F1 in [ɛ̃ œ̃].

Nasal Unit = [ɛ̃ œ̃] Dependent variable = F2 N = 177 Grand mean = 0.77		Deviance: 335 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ɛ̃/	0.178	120	0.0171
	/œ̃/	-0.178	57	
Non-significant factor groups were Speaker sex (p=0.202) and Phoneme*Sex (p=0.191).				

Table 5.65. All Young speakers: Results of mixed-effects regression for F2 in [ɛ̃ œ̃].

For /ã/, both the sequential and the non-sequential units show the same pattern. The models for F1 and F2 are presented in Tables 5.66 to 5.69. In all cases, the only significant predictor is the positive correlation between F1 and F2: low vowels also tend to be articulated further forward.

Nasal Unit = [ãN] Dependent variable = F1 N = 234 Grand mean = 0.664		Deviance: 540 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.261	234	0.0142
Non-significant factor groups were Syllable type (p=0.0595), Speaker sex (p=0.754), Lexical frequency (p=0.899).				

Table 5.66. All Young speakers: Results of mixed-effects regression for F1 in [ãN].

Nasal Unit = [ãN] Dependent variable = F2 N = 234 Grand mean = -0.436		Deviance: 309 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.098	234	0.0114
Non-significant factor groups were Speaker sex (p=0.703), Lexical frequency (p=0.722), and Syllable type (p=0.984).				

Table 5.67. All Young speakers: Results of mixed-effects regression for F2 in [ãN].

Nasal Unit = [ã] Dependent variable = F1 N = 208 Grand mean = 0.616		Deviance: 471 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.216	208	0.0226
Non-significant factor groups were Syllable type (p=0.221), Lexical frequency (p=0.267), and Speaker sex (p=0.385).				

Table 5.68. All Young speakers: Results of mixed-effects regression for F1 in [ã].

Nasal Unit = [ã] Dependent variable = F2 N = 208 Grand mean = -0.483		Deviance: 337 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.109	208	0.0314
Non-significant factor groups were Lexical frequency (p=0.167), Speaker sex (p=0.619), and Syllable type (p=0.679).				

Table 5.69. All Young speakers: Results of mixed-effects regression for F2 in [ã].

For the other back nasal vowel, /ɔ̃/, both the F1 and F2 models both in sequential (Tables 5.70 and 5.71) and non-sequential (Tables 5.72 and 5.73) units show a similar significant positive correlation between the first two formants: lower vowels also tend to be centralised. In addition to this, F2 in sequential nasal units is significantly influenced by syllable type ($p \leq 0.05$) (see Table 5.71): final closed syllables favour higher F2 values; medial (open) syllables favour lower F2 values; final open syllables are intermediate.

Nasal Unit = [ɔ̃N] Dependent variable = F1 N = 276 Grand mean = -0.501		Deviance: 698 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.322	276	5.81e-07
Non-significant factor groups were Lexical frequency (p=0.519), Syllable type (p=0.617), and Speaker sex (p=0.83).				

Table 5.70. All Young speakers: Results of mixed-effects regression for F1 in [ɔ̃N].

Nasal Unit = [ɔ̃N] Dependent variable = F2 N = 276 Grand mean = -0.623		Deviance: 654 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.278	276	2.85e-07
Syllable type	/Cɔ̃C#/ 	0.163	89	0.038
	/Cɔ̃#/ 	0.043	93	
	/ɔ̃CV(C)#/ 	-0.206	94	
Non-significant factor groups were Speaker sex (p=0.357) and Lexical frequency (p=0.882).				

Table 5.71. All Young speakers: Results of mixed-effects regression for F2 in [ɔ̃N].

Nasal Unit = [ɔ̃] Dependent variable = F1 N = 125 Grand mean = -0.447		Deviance: 338 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.25	125	0.00313
Non-significant factor groups were Syllable type (p=0.133), Lexical frequency (p=0.495), and Speaker sex (p=0.567).				

Table 5.72. All Young speakers: Results of mixed-effects regression for F1 in [ɔ̃].

Nasal Unit = [ɔ̃] Dependent variable = F2 N = 125 Grand mean = -0.345		Deviance: 341 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.257	125	0.00345
Non-significant factor groups were Lexical frequency (p=0.277), Speaker sex (p=0.528), and Syllable type (p=0.926).				

Table 5.73. All Young speakers: Results of mixed-effects regression for F2 in [ɔ̃].

The phonetic distinctions, made on the basis of F1 and F2, between /ã/ and /ɔ̃/ are modelled statistically in Tables 5.74 and 5.75 for sequential nasal units.

‘Phoneme’ is a significant predictor in both models (p≤0.01): the back nasal vowels

are distinguished phonetically on the basis of vowel height (/ä/ being significantly lower than /õ/) and vowel frontness/backness (/ä/ being centralised relative to /õ/). These findings suggest that the primary distinction between the back nasal vowels is not simply one of lip-rounding, but also one of vowel height.

Nasal Unit = [ãN ɔN] Dependent variable = F1 N = 510 Grand mean = 0.034		Deviance: 1291 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.544	234	2.06e-24
	/ɔ/	-0.544	276	
Non-significant factor groups were Speaker sex (p=0.78) and Phoneme*Sex (p=0.163).				

Table 5.74. All Young speakers: Results of mixed-effects regression for F1 in [äN õN].

Nasal Unit = [ãN ɔ̃N] Dependent variable = F2 N = 510 Grand mean = -0.537		Deviance: 1104 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.104	234	0.00427
	/ɔ̃/	-0.104	276	
Non-significant factor groups were Speaker sex (p=0.0965) and Phoneme*Sex (p=0.353).				

Table 5.75. All Young speakers: Results of mixed-effects regression for F2 in [äN õN].

In non-sequential units, ‘phoneme’ is also a significant predictor of F1 (Table 5.76): /ä/ is significantly lower than /õ/ confirming that the vowels are distinguished consistently on the basis of vowel height. For F2, on the other hand, no significant predictors are included in the model (Table 5.77). This shows that, when no nasal consonant coda is present, there is no significant phonetic distinction made between /ä/ and /õ/ on the basis of F2: the /ä/ vowel is not centralised relative to /õ/. The

non-standard [ṽN] phonetic environment appears to favour a non-standard (fronter) realisation of /ã/ whereas the sequential environment [ṽ] favours more standard-like ‘back’ vowels.

Nasal Unit = [ã ɔ̃] Dependent variable = F1 N = 333 Grand mean = 0.217		Deviance: 841 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ã/	0.533	208	2.18e-16
	/ɔ̃/	-0.533	125	
Non-significant factor groups were Speaker sex (p=0.41) and Phoneme*Sex (p=0.961).				

Table 5.76. All Young speakers: Results of mixed-effects regression for F1 in [ã ɔ̃].

Nasal Unit = [ã ɔ̃] Dependent variable = F2 N = 333 Grand mean = -0.431	Deviance: 758 Degrees of freedom: 7
Non-significant factor groups were Phoneme (p=0.117), Speaker sex (p=0.782), and Phoneme*Sex (p=0.0788).	

Table 5.77. All Young speakers: Results of mixed-effects regression for F2 in [ã ɔ̃].

5.2.3.2 LIP-ROUNDING AND F3

The acoustic and statistical analysis of F3 forms the basis of this section, focusing on F3 as an acoustic correlate of lip-rounding.

Figure 5.29 presents raw F3 data for individual male speakers for nasal vowels occurring in sequential nasal units. Only one young male speaker, Speaker £, exhibits separate F3 distributions for the front nasal vowels, /ẽ/ and /œ̃/. For all other speakers, there is substantial F3 overlap between the front nasal vowels suggesting that they are not consistently distinguished on the basis of F3 and that these speakers may not realise /œ̃/ with rounded lips. For the back nasal vowels,

only Speaker £ realises /ã/ and /õ/ with completely separate F3 distributions in sequential units. Since all other speakers do not consistently distinguish between these vowels on the basis of F3, it appears that young male speakers are not involved in the supralocal change that sees /ã/ and /õ/ distinguished primarily on the basis of lip-rounding of the latter (cf. Hansen, 1998).

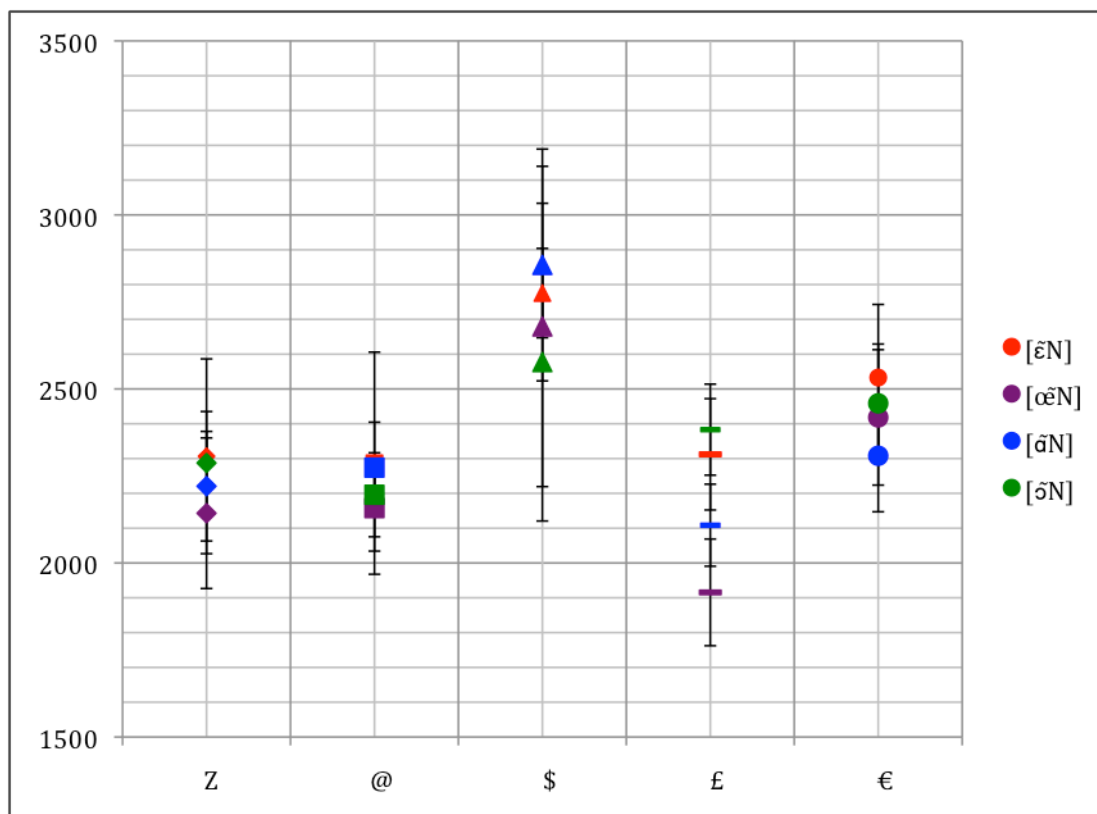


Figure 5.29. Young Male Speakers: Mean F3 values and standard deviations for nasal vowels in sequential nasal units.

The F3 data for individual male speakers for vowels in non-sequential nasal units are presented in Figure 5.30. All speakers show completely overlapping distributions for the front nasal vowels, suggesting that these vowels are not distinguished by lip-rounding. It is interesting to note that this includes Speaker £, who realised non-sequential [ẽ] and [œ] as phonetically distinct on the basis of F3. All speakers exhibit overlapping distributions for the back nasal vowels, suggesting that young male speakers do not readily distinguish between these vowels using lip-rounding.

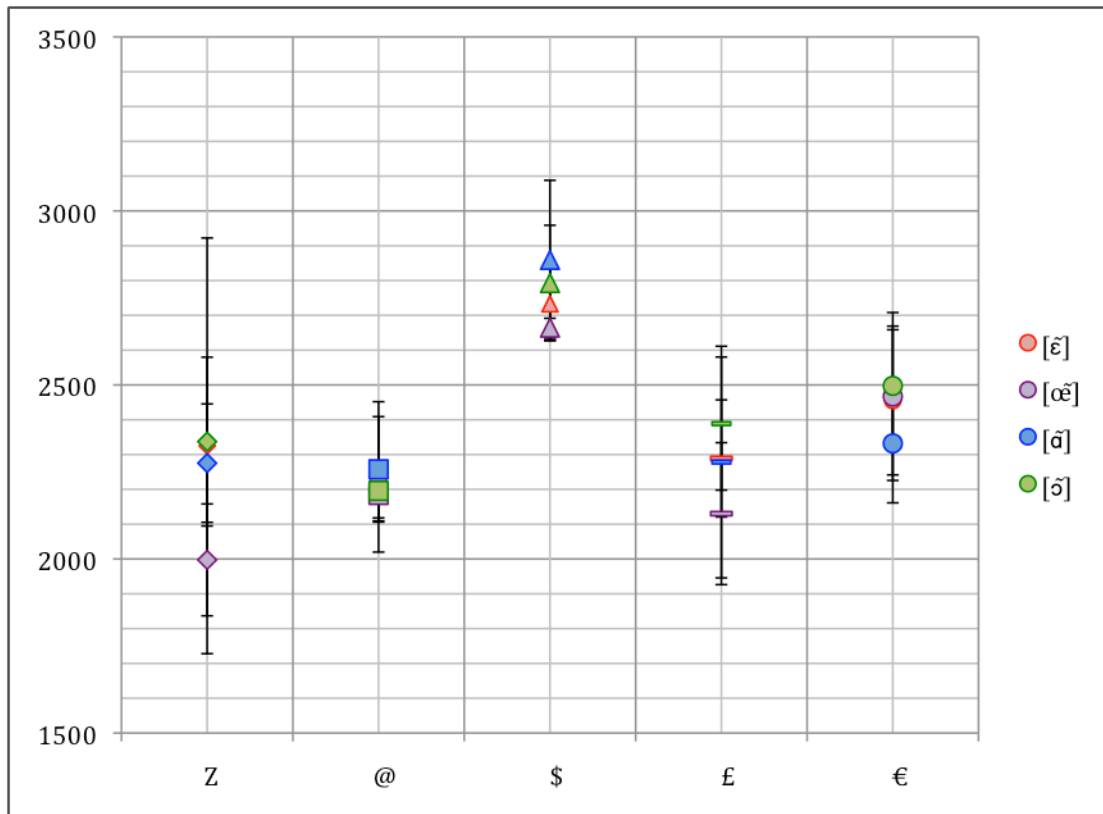


Figure 5.30. Young Male Speakers: Mean F3 values and standard deviations for nasal vowels in non-sequential nasal units.

For individual young female speakers, the raw F3 data for both sequential units (Figure 5.31) and non-sequential units (Figure 5.32) show overlapping F3 distributions for all speakers between /ẽ/ and /œ̃/, and between /ã/ and /õ/. These data suggest that young female speakers do not make a consistent lip-rounding distinction between the front, or between the back, nasal vowels.

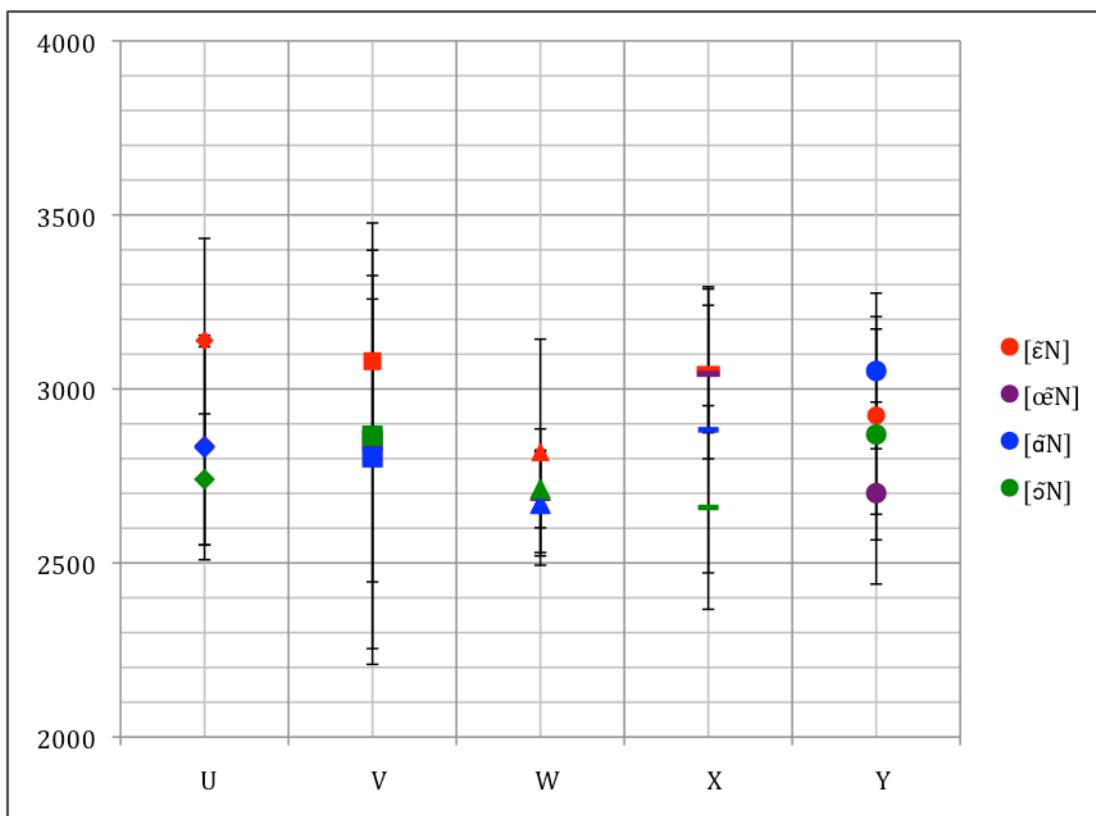


Figure 5.31. Young Female Speakers: Mean F3 values and standard deviations for nasal vowels in sequential nasal units.

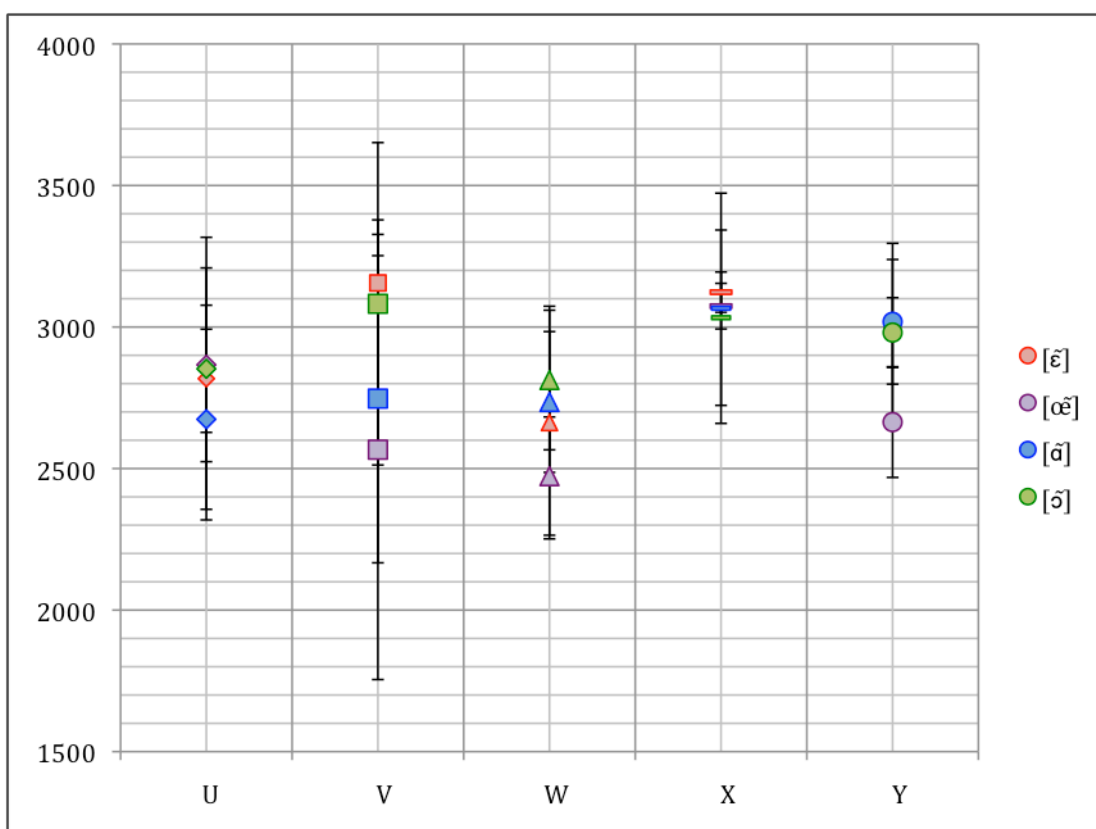


Figure 5.32. Young Female Speakers: Mean F3 values and standard deviations for nasal vowels in non-sequential nasal units.

5.2.3.2.1. MODELLING LIP-ROUNDING AND F3

Beginning with the front nasal vowels in sequential nasal units, ‘phoneme’ is returned by the regression analysis as a highly significant predictor of F3 (Table 5.78): [œN] favours lower F3 values than [ɛN]. The same effect is found in non-sequential [ɛ] and [œ] (Table 5.79), suggesting that younger speakers are using two front nasal vowels and that these speakers have not (fully) adopted the supralocal merger. There was, however, evidence in the raw data to suggest that distributional overlap between these vowels is high for some young speakers.

Nasal Unit = [ɛ̃N œ̃N] Dependent variable = F3 N = 285 Grand mean = 0.112		Deviance: 825 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ɛ̃/	0.326	187	0.00162
	/œ̃/	-0.326	98	
Non-significant factor groups were Speaker sex (p=0.397) and Phoneme*Sex (p=0.506).				

Table 5.78. All Young speakers: Results of mixed-effects regression for F3 in [ɛN œN].

Nasal Unit = [ɛ̃ œ̃] Dependent variable = F3 N = 177 Grand mean = 0.015		Deviance: 537 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ɛ̃/	0.257	120	0.0199
	/œ̃/	-0.257	57	
Non-significant factor groups were Speaker sex (p=0.635) and Phoneme*Sex (p=0.873).				

Table 5.79. All Young speakers: Results of mixed-effects regression for F3 in [ɛ œ].

For the back nasal vowels in sequential nasal units, no significant predictors are included in the F3 model (Table 5.80). This confirms that [ãN] and [ɜ̃N] are not distinguished phonetically on the basis of F3 when they occur with nasal consonant

codas. In non-sequential units, by contrast, ‘phoneme’ is returned as a highly significant predictor of the variation observed (Table 5.81): [ɔ̃] is shown to favour significantly higher F3 values than [ã], which is the reverse of what might be expected, given that low F3 values are associated with lip-rounding.

Nasal Unit = [ãN ɔ̃N] Dependent variable = F3 N = 510 Grand mean = -0.095	Deviance: 1349 Degrees of freedom: 7
Non-significant factor groups were Phoneme (p=0.139), Speaker sex (p=0.525), and Phoneme*Sex (p=0.061).	

Table 5.80. All Young speakers: Results of mixed-effects regression for F3 in [ãN ɔ̃N].

Nasal Unit = [ã ɔ̃] Dependent variable = F3 N = 333 Grand mean = 0.042		Deviance: 903 Degrees of freedom: 7		
Factor Group	Factor	Coeff.	N	P-value
Phoneme	/ɔ̃/	0.197	125	0.000295
	/ã/	-0.197	208	
Non-significant factor groups were Speaker sex (p=0.719), and Phoneme*Sex (p=0.291).				

Table 5.81. All Young speakers: Results of mixed-effects regression for F3 in [ã ɔ̃].

5.2.3.3 NASAL CONSONANT CODAS

The frequency distribution for nasal consonant presence versus absence in each of the nasal units is presented in Table 5.82. With the possible exception of /ã/, the rate of consonant presence is relatively similar across nasal vowels. There does not seem to be any strong effect of phonemic identity on consonant presence. Overall, consonant presence is in the majority in the younger generation across nasal vowels with the /ã/ vowel exhibiting the lowest rate of occurrence.

Nasal Unit	Consonant presence/absence		
	N	% Sequential	% Non-Sequential
/ẽ/	307	61	39
/œ/	155	63	37
/ã/	442	53	47
/õ/	401	69	31

Table 5.82. Young speakers: The relationship between nasal consonant presence/absence and nasal vowel.

The frequency distribution by syllable type is presented in Table 5.83. As was the case for the middle and older generations, the range of syllabic contexts in which /œ/ occurs in the data set is restricted: there are no tokens in final closed syllables and only four token in medial open syllables. In final open syllables, where the majority of tokens occur, 64% of /œ/ vowels occur in a sequential nasal unit. For /ẽ/, final closed syllables appear to favour nasal consonant presence (83%), followed by medial open syllables (71%). In final open syllables, on the other hand, young speakers realise the majority (56%) of nasal vowels without a nasal consonant coda. A similar pattern is displayed for /õ/, though the percentages vary somewhat: 82% in final closed syllables; 66% in medial open syllables; 62% in final open syllables. For the /ã/ nasal vowel, medial open syllables contain the highest number of consonantal codas (61%), followed by final closed syllables (57%). The majority form in final open syllables is consonant absence (59%), akin to the finding for /ẽ/ above. When all vowels are considered together, the following pattern emerges for

consonant presence: 69% in final closed syllables; 66% in medial open syllables; 53% in final open syllables.

Consonant presence/absence				
Nasal Unit	N	Syllable Type	% Sequential	% Non-Sequential
/ẽ/	58	/C̃ṽC#/	83	17
	110	/ṽCV(C)#/	71	29
	139	/C̃ṽ#/	44	56
/œ/	0	/C̃ṽC#/	ND	ND
	4	/ṽCV(C)#/	50	50
	151	/C̃ṽ#/	64	36
/ã/	145	/C̃ṽC#/	57	43
	147	/ṽCV(C)#/	61	39
	150	/C̃ṽ#/	41	59
/õ/	109	/C̃ṽC#/	82	18
	142	/ṽCV(C)#/	66	34
	150	/C̃ṽ#/	62	38
Total	326	/C̃ṽC#/	69	31
	403	/ṽCV(C)#/	66	34
	576	/C̃ṽ#/	53	47

Table 5.83. Young speakers: The relationship between nasal consonant presence/absence and syllable type. ND = No data.

The logistic regression model for consonant presence/absence is presented in Table 5.84. The phonemic identity of the vowels does not have a significant effect on the rate of nasal consonant presence ($p=0.142$). The only significant result returned by the regression analysis is syllable type, where the magnitude of the effect is large: final closed syllables and medial open syllables favour consonant presence; final

open syllables favour consonant absence. This confirms that the pattern observed in the raw data.

Nasal Unit = /ẽ œ ã õ/ Dependent variable = Consonant absence/presence Response variable = Consonant presence N = 1305 Grand mean = 0.609		Deviance: 1503 Degrees of freedom: 10		
Factor Group	Factor	Log Odds	N	P-value
Syllable type	/C $\tilde{v}$ C#/	0.469	312	6.3e-06
	/ $\tilde{v}$ CV(C)#/	0.311	403	
	/C $\tilde{v}$ #/	-0.780	590	
Non-significant factor groups were Lexical frequency (0.0962), Phoneme (0.142), and Speaker sex (0.89).				

Table 5.84. All Young Speakers: Results of mixed-effects logistic regression for consonant absence/presence.

5.2.3.4 SUMMARY OF THE NASAL VOWELS FOR THE YOUNG GENERATION

The potential phonological contrast between /ẽ/ and /œ/ was maintained: they were distinguished in the same way in both phonetic environments. No height distinction was found but there were significant differences in F2 and F3, with /œ/ favouring lower F2 and F3 values overall. This indicates that young speakers realise the traditional phonetic distinction on the basis of lip-rounding (and possibly frontness/backness). For the back nasal vowels, different patterns were evident in sequential and non-sequential nasal units. In both cases, /ã/ was distinguished from /õ/ on the basis of vowel height with /ã/ being consistently lower in the vowel space. In sequential nasal units, the back vowels were distinguished on the basis of F2 but not F3. In non-sequential nasal units, on the other hand, the reverse was the

case. However, the significant F3 distinction between the vowels was in the opposite direction than would be expected: /õ/ has significantly lower F3 values than /ã/.

Various constraints were shown to affect variation in the nasal vowels. For /ẽ/, no significant predictors were found for F1 or F2 in sequential nasal units but in non-sequential units, on the other hand, there was a significant positive F1/F2 correlation and a strong effect of syllable type on vowel height: low vowels in final syllables and high vowels in medial syllables. For /œ/, no significant effects were found in the sequential environment, and in the non-sequential units, F1 alone was shown to be conditioned by syllable type (though token counts were small) and to display a negative correlation with lexical frequency: high frequency words contained higher vowels. Both /ã/ and /õ/ exhibit a positive F1/F2 correlation in sequential and non-sequential nasal units: lower vowels in each case tend to be fronted/centralised. If F2 is taken to be an acoustic correlate of articulatory configuration (bearing in mind the potential effect of nasalisation and lip-rounding on F2), then non-standard [ẽN] phonetic environments appeared to favour a non-standard (fronter) realisations of the /ã/ vowel whereas the sequential environment [ẽ] appeared to favour more standard-like ‘back’ vowels.

Finally, the presence of a nasal consonant was shown to be affected significantly by syllable type for young speakers: final closed syllables and medial open syllables were shown to favour consonant presence while final open syllables were less favourable to the presence of a nasal consonant coda.

5.2.4 CHANGE IN APPARENT TIME

The changing patterns of phonological contrast between the nasal vowels over time are discussed qualitatively in this section. The examination focuses on evidence for the maintenance of a phonetic distinction between the front nasal vowels and between the back nasal vowels. The results of the regression models, presented above, for F1, F2 and F3 for each vowel pair in each generation form the basis of this discussion.

All speakers in all generations were shown to make a phonetic distinction between /ẽ/ and /œ̃/ on the basis of F2: /œ̃/ values were significantly lower than /ẽ/ values in both sequential and non-sequential nasal units and the younger generations do not appear to have adopted the supralocal merger. None of the generations made a consistent vowel height (F1) distinction between the front nasal vowels and F3 was used variably to distinguish the vowels phonetically: ‘phoneme’ was a significant predictor of F3 for old speakers in sequential nasal units and for young speakers in both phonetic contexts.

For the back nasal vowels, all three generations distinguish significantly between /ã/ and /õ/ on the basis of F1 and F2: /ã/ is lower and more centralised than /õ/. The only exception to this is that younger speakers do not make a significant F2 distinction between non-sequential [ã] and [õ]. There was no regular F3 distinction made between the back nasal vowels in any of the three generations. Again, there is stability in the phonological system over time in that the phonemic contrast is maintained and is realised phonetically in a similar way by all generations, with no clear evidence for a supralocal change in progress, whereby /ã/ is becoming

more similar to /ɔ̃/ with the primary distinction between them being made on the basis of lip-rounding of the latter.

5.2.4.1 MODELLING PHONETIC CHANGE IN APPARENT TIME

This section models statistically change in apparent time for each of the nasal vowels (F1, F2, F3) in sequential and non-sequential nasal units. Individual models examine the effect of speaker age, speaker sex and the age*sex interaction on vowel quality. A statistical model for change in the occurrence of consonant presence over time will also be presented.

Beginning with /ɛ̃/ in sequential nasal units, F1 is shown to be unaffected by speaker age (Table 5.85) while the same is not true of F2 (Table 5.86): middle speakers favour high F2 values; old speakers favour low F2 values; young speakers are intermediate to the two older generations. This finding suggests that middle speakers realise significantly fronter [ɛ̃N] vowels than older speakers and that younger speakers fall somewhere in between. There is a significant effect of speaker sex on F3 (Table 5.87): male speakers realised higher F3 values than female speakers. The magnitude of this effect is, however, very small.

Dependent variable = F1 N = 741 Grand mean = -0.223	Deviance: 1587 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.714), Speaker sex (p=0.736), and Age*Sex (p=0.428).	

Table 5.85. Three generations, all speakers: regression model for [ɛ̃N] F1.

Dependent variable = F2 N = 741 Grand mean = 1.175		Deviance: 1405 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Middle	0.100	289	0.0219
	Young	0.063	187	
	Old	-0.164	265	
Non-significant factor groups were Speaker sex (p=0.738) and Age*Sex (p=0.902).				

Table 5.86. Three generations, all speakers: regression model for [ɛN] F2.

Dependent variable = F3 N = 741 Grand mean = 0.2		Deviance: 2030 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Sex	Male	0.093	375	0.0368
	Female	-0.093	366	
Non-significant factor groups were Age (p=0.0891) and Age*Sex (p=0.079).				

Table 5.87. Three generations, all speakers: regression model for [ɛN] F3.

In non-sequential units, no change in apparent time is evident for /ɛ/. The regression models for F1, F2 and F3 are presented in Tables 5.88, 5.89 and 5.90 respectively. The F1 model includes a significant effect for speaker sex: female speakers favour higher F1 values (lower vowels) than male speakers.

Dependent variable = F1 N = 288 Grand mean = -0.019		Deviance: 753 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Sex	Female	0.148	159	0.0174
	Male	-0.148	129	
Non-significant factor groups were Age (p=0.0339) and Age*Sex (p=0.975).				

Table 5.88. Three generations, all speakers: regression model for [ɛ] F1.

Dependent variable = F2 N = 288 Grand mean = 0.986	Deviance: 615 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.792), Speaker sex (p=0.743), and Age*Sex (p=0.0677).	

Table 5.89. Three generations, all speakers: regression model for [ē] F2.

Dependent variable = F3 N = 288 Grand mean = 0.182	Deviance: 854 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.726), Speaker sex (p=0.131), and Age*Sex (p=0.0961).	

Table 5.90. Three generations, all speakers: regression model for [ē] F3.

The F1 model for /œ̃/ in sequential nasal units is presented in Table 5.91.

The interaction between speaker age and speaker sex is returned by the analysis as significant: there is more phonetic difference between male and female speakers in the older generation and the middle generation than in the young generation, where there is very little difference in vowel height for male and female speakers. The model for F2, in Table 5.92, includes speaker age as a significant predictor: old speakers have lower F2 values than middle speaker who in turn have lower F2 values than young speakers. This is evidence for change in apparent time: /œ̃/ is significantly fronter (or less round) in the acoustic vowel space for each successive generation. There are no significant predictors included in the F3 model (Table 5.93).

Dependent variable = F1 N = 339 Grand mean = -0.504		Deviance: 854 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age*Sex	Old: Female	0.149	55	0.03
	Middle: Male	0.140	60	
	Young: Male	0.009	42	
	Young: Female	-0.009	56	
	Middle: Female	-0.140	57	
	Old: Male	-0.149	69	
Non-significant factor groups were Age (p=0.182) and Speaker sex (p=0.361).				

Table 5.91. Three generations, all speakers: regression model for [œN] F1.

Dependent variable = F2 N = 339 Grand mean = 0.386		Deviance: 604 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Young	0.153	98	0.00298
	Middle	0.062	117	
	Old	-0.214	124	
Non-significant factor groups were Speaker sex (p=0.121) and Age*Sex (p=0.41).				

Table 5.92. Three generations, all speakers: regression model for [œN] F2.

Dependent variable = F3 N = 339 Grand mean = -0.238	Deviance: 863 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.901), Speaker sex (p=0.579), and Age*Sex (p=0.381).	

Table 5.93. Three generations, all speakers: regression model for [œN] F3.

In non-sequential nasal units, variation in the front rounded nasal vowel is not predicted by speaker age, speaker sex or their interaction for F1, F2 or F3. Regression models are provided in Tables 5.94, 5.95 and 5.96 respectively. This shows that the quality of /œ/ is relatively stable in non-sequential units across the generations.

Dependent variable = F1 N = 125 Grand mean = -0.28	Deviance: 318 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.794), Speaker sex (p=0.763), and Age*Sex (p=0.721).	

Table 5.94. Three generations, all speakers: regression model for [œ] F1.

Dependent variable = F2 N = 125 Grand mean = 0.38	Deviance: 200 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.153), Speaker sex (p=0.701), and Age*Sex (p=0.558).	

Table 5.95. Three generations, all speakers: regression model for [œ] F2.

Dependent variable = F3 N = 125 Grand mean = -0.203	Deviance: 346 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.413), Speaker sex (p=0.387), and Age*Sex (p=0.408).	

Table 5.96. Three generations, all speakers: regression model for [œ] F3.

The analyses of /ã/ exhibit substantial evidence for change in apparent time. The model for F1 presented in Table 5.97, for sequential units, contains no significant predictors: the height of /ã/ is stable across the generations, occupying a low position in the acoustic vowel space. In the model for F2, presented in Table 5.98, a strong apparent time effect is reported ($p \leq 0.01$): older speakers favour the highest F2 values, followed by middle speakers and young speakers favour the lowest F2 values. Speaker age is also returned as a significant effect in the regression model for F3 (Table 5.99). In this case, both young and old speakers appear to favour low F3 values while middle speakers favour high F3 values. The magnitude of this effect is relatively low, however, and the strength of the effect is relatively weak.

Dependent variable = F1 N = 848 Grand mean = 0.775	Deviance: 2184 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.352), Speaker sex (p=0.737), and Age*Sex (p=0.138).	

Table 5.97. Three generations, all speakers: regression model for [āN] F1.

Dependent variable = F2 N = 848 Grand mean = -0.237		Deviance: 1273 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Old	0.254	342	9.32e-07
	Middle	-0.068	272	
	Young	-0.186	234	
Non-significant factor groups were Speaker sex (p=0.348) and Age*Sex (p=0.184).				

Table 5.98. Three generations, all speakers: regression model for [āN] F2.

Dependent variable = F3 N = 848 Grand mean = -0.008		Deviance: 2431 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Middle	0.156	272	0.0472
	Young	-0.072	234	
	Old	-0.083	342	
Non-significant factor groups were Speaker sex (p=0.12) and Age*Sex (p=0.171).				

Table 5.99. Three generations, all speakers: regression model for [āN] F3.

In non-sequential nasal units, significant effects are returned in the analysis of F1 and F2, but not F3. The F1 regression model for [ā] is provided in Table 5.100 where speaker age is included as a significant predictor: old speakers favour high F1 values (low vowels); middle speakers favour raised variants (low F1 values); young speakers are intermediate. In Table 5.101, the regression model for F2 also shows evidence of apparent time change in non-sequential nasal units: old speakers favour fronter/centralised vowels, followed by middle speakers, while young speakers

favour backed variants of /ã/. The F3 model, presented in Table 5.102, contains no significant predictors of the variation observed.

Dependent variable = F1 N = 452 Grand mean = 0.537		Deviance: 1216 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Old	0.169	78	0.0269
	Young	0.052	208	
	Middle	-0.221	166	
Non-significant factor groups were Speaker sex (p=0.697) and Age*Sex (p=0.776).				

Table 5.100. Three generations, all speakers: regression model for [ã] F1.

Dependent variable = F2 N = 452 Grand mean = -0.41		Deviance: 802 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Old	0.170	78	0.0112
	Middle	-0.054	166	
	Young	-0.116	208	
Non-significant factor groups were Speaker sex (p=0.88) and Age*Sex (p=0.47).				

Table 5.101. Three generations, all speakers: regression model for [ã] F2.

Dependent variable = F3 N = 452 Grand mean = -0.035	Deviance: 1316 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.67), Speaker sex (p=0.0746), and Age*Sex (p=0.164).	

Table 5.102. Three generations, all speakers: regression model for [ã] F3.

The F1, F2 and F3 models for /ɜ/ in sequential nasal units are presented in Tables 5.103, 5.104 and 5.105 respectively. There is no significant F1 difference between the generations: vowel height appears to be relatively stable across the age groups. For F2, on the other hand, speaker age is returned as a highly significant predictor with regression coefficients indicating a (low magnitude) change in

apparent time: younger generations realise /ɜ/ as progressively more centralised than old speakers. The F3 model does not show an apparent time effect.

Dependent variable = F1 N = 909 Grand mean = -0.419	Deviance: 2267 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.725), Speaker sex (p=0.736), and Age*Sex (p=0.78).	

Table 5.103. Three generations, all speakers: regression model for [ɜN] F1.

Dependent variable = F2 N = 909 Grand mean = -0.819		Deviance: 1885 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Young	0.192	276	0.00364
	Middle	-0.017	316	
	Old	-0.175	317	
Non-significant factor groups were Speaker sex (p=0.395) and Age*Sex (p=0.422).				

Table 5.104. Three generations, all speakers: regression model for [ɜN] F2.

Dependent variable = F3 N = 909 Grand mean = -0.102	Deviance: 2483 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.899), Speaker sex (p=0.858), and Age*Sex (p=0.105).	

Table 5.105. Three generations, all speakers: regression model for [ɜN] F3.

In non-sequential units, vowel height is equally stable across the generations (Table 5.106). The apparent time centralisation of /ɜ/, indicated by progressive F2-raising in younger generations, is again returned as significant (Table 5.107). However, this is also accompanied by a parallel apparent time effect on F3 not present for [ɜN] (Table 5.108).

Dependent variable = F1 N = 340 Grand mean = -0.419	Deviance: 890 Degrees of freedom: 9
Non-significant factor groups were Age (p=0.255), Speaker sex (p=0.49), and Age*Sex (p=0.951).	

Table 5.106. Three generations, all speakers: regression model for [ɜ] F1.

Dependent variable = F2 N = 340 Grand mean = -0.594		Deviance: 807 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Young	0.272	125	0.023
	Middle	-0.087	133	
	Old	-0.185	82	
Non-significant factor groups were Speaker sex (p=0.73) and Age*Sex (p=0.387).				

Table 5.107. Three generations, all speakers: regression model for [ɔ̃] F2.

Dependent variable = F3 N = 340 Grand mean = 0.064		Deviance: 901 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Age	Young	0.272	125	0.0109
	Middle	-0.045	133	
	Old	-0.226	82	
Non-significant factor groups were Speaker sex (p=0.701) and Age*Sex (p=0.131).				

Table 5.108. Three generations, all speakers: regression model for [ɔ̃] F3.

Finally, the apparent time change in the use of nasal consonant codas in nasal units is modelled in Table 5.109. Three predictors are returned as significant: speaker age, syllable type, and the interaction between speaker age and phonemic identity. There is a clear apparent time change taking place: older speakers use the most nasal consonants, followed by middle generation speakers, while young speakers use the fewest. Syllable type is a constant predictor of nasal consonant presence across all generation, as seen in the individual synchronic models for each generation: final closed and medial open syllables favour consonant presence while final open syllables are least favourable to nasal consonant codas. Finally, the significant interaction effect between speaker age and phonemic identity reveals complex patterns of nasal consonant occurrence.

Nasal Unit = / $\tilde{\epsilon}$ $\tilde{\alpha}$ $\tilde{\omega}$ / Dependent variable = Consonant absence/presence Response variable = Consonant presence N = 4042 Grand mean = 0.702		Deviance: 4080 Degrees of freedom: 23		
Factor Group	Factor	Log Odds	N	P-value
Age*Phoneme	Middle: / $\tilde{\epsilon}$ /	0.485	371	1.31e-05
	Young: / $\tilde{\alpha}$ /	0.483	442	
	Young: / $\tilde{\omega}$ /	0.383	401	
	Middle: / $\tilde{\alpha}\tilde{\epsilon}$ /	0.350	155	
	Old: / $\tilde{\epsilon}$ /	0.189	351	
	Old: / $\tilde{\omega}$ /	0.178	399	
	Old: / $\tilde{\alpha}\tilde{\epsilon}$ /	-0.159	154	
	Young: / $\tilde{\alpha}\tilde{\epsilon}$ /	-0.191	155	
	Old: / $\tilde{\alpha}$ /	-0.208	420	
	Middle: / $\tilde{\alpha}$ /	-0.274	438	
	Middle: / $\tilde{\omega}$ /	-0.561	449	
	Young: / $\tilde{\epsilon}$ /	-0.675	307	
Syllable type	/C $\tilde{\nu}$ C# /	0.507	996	5.59e-14
	/ $\tilde{\nu}$ CV(C)# /	0.367	1268	
	/C $\tilde{\nu}$ # /	-0.874	1778	
Age	Old	0.632	1324	0.00417
	Middle	-0.025	1413	
	Young	-0.607	1305	
Non-significant factor groups were Speaker sex (p=0.0616), Phoneme (p=0.298), Age*Syllable (p=0.166), and Age*Sex (p=0.214).				

Table 5.109. Three generations, all speakers: regression model for Consonant presence/absence.

For / $\tilde{\epsilon}$ /, middle speakers use the most nasal consonants, followed by old speakers whereas young speakers use nasal consonants extremely infrequently with this vowel. For / $\tilde{\alpha}$ /, middle speakers again use more sequential nasal units, followed by older and younger speakers who show a similar magnitude negative correlation. For

/ã/, young speakers use the most non-standard (sequential) variants, while both old and middle speakers show a negative effect of similar magnitude. Finally, for /õ/, young speakers also use the most nasal consonant codas, followed by older speakers, while middle speakers strongly disfavour consonant presence.

From a phonological perspective, the front nasal vowels, /ẽ/ and /œ/, are distinguished phonetically by speakers in all generations: this phonemic contrast appears to be relatively stable. In the phonetic analysis, /œ/ in non-sequential nasal units was shown to be undergoing apparent time change: the vowel was ‘acoustically’ fronted in the young generation. It is possible that this F2-raising is indicative of a merger between the front nasal vowels (akin to that of the supralocal norm) by young speakers in the non-sequential (but not the non-standard, sequential) phonetic environment.

The phonemic distinction between the back nasal vowels, /ã/ and /õ/, is also realised phonetically by all generations with /ã/ being realised a significantly lower and centralised in the vowel space than /õ/. The phonetic environment (in terms of the presence of a nasal consonant) did not have an effect on this distinction. In both environments, however, F2 was shown to be undergoing an apparent time change involving significant backing of /ã/ in younger generations. A consequence of this was that younger speakers did not make a significant F2 distinction between /ã/ and /õ/ in non-sequential units. Additionally, /õ/ appeared to also be undergoing change in F2 in that it was significantly centralised over time.

Apparent time change was evident in the frequency of occurrence of consonant codas with the lowest number of non-standard variants used by young speakers. Syllable type was shown to significantly effect nasal consonant presence in all generations. The apparent time analysis revealed complex relationships between generational differences and the effect of the nasal vowel's phonemic identity on consonant presence.

5.3 EVIDENCE FOR REGIONAL DIALECT LEVELLING

The evidence for apparent-time change presented in this chapter will now be discussed in relation to Kerswill's (2003) RDL model (see Section 1.3.1.3). The discussion examines evidence for the linguistic mechanisms of levelling 'proper' and geographical diffusion in the mid- and nasal vowel systems of the RF of Béarn.

Changes identified in the RF of Béarn are interpreted relative to the RF system presented for the oldest generation of speakers. The outcomes of language contact established in Chapter 4 are thus taken as the baseline norm, a baseline that deviates somewhat from traditional descriptions of southwestern RF (see Section 2.3.1).

We have seen that the sociolinguistic mechanism of levelling 'proper' leads to the reduction of localised features between adjacent varieties over a relatively compact geographical space (see Section 1.3.1.1). This mechanism of change is linked to the adoption of pan-regional features leading to a reduction in differences between varieties in contact from a regional perspective (cf. the increasing similarity of north-eastern British English dialects due to the adoption of features such as [e:]

for the FACE vowel). In Béarn, we may identify evidence for levelling ‘proper’ in the adoption by younger generations of DSP or majority southern variants.

Geographical diffusion, on the other hand, was shown to be the linguistic mechanism promoting the adoption of non-local features into regional varieties (see Section 1.3.1.2). This mechanism may be seen to act over a substantially larger geographical space than levelling ‘proper’ (cf. the adoption of TH-fronting by some Scottish English varieties). Geographical diffusion is therefore linked more directly to the process of ‘supralocalisation’ whereby differences between varieties are reduced over a wider geographical area. We may identify evidence for geographical diffusion in the RF of Béarn in the adoption by younger generations of supralocal French features diffusing from the north of France (see Section 2.2.2).

The interplay of these linguistic mechanisms leads to what Kerswill (2003) calls RDL, that is, the adoption by local speakers of both pan-regional and supralocal forms. Evidence for RDL in the RF of Béarn may be found in the concomitant adoption of majority southern, DSP, features as well as, crucially, the adoption of majority northern (supralocal French) features.

We may note that while ‘supralocalisation’ involves the spread of the northern statistical norm (supralocal French or *norme*, cf. Garmadi, 1981), ‘standardisation’, on the other hand, involves convergence towards the ‘ideologised’ prescriptive norm (SF or *sur-norme*, cf. Garmadi, 1981). The processes which promote convergence towards these respective norms are often associated because they are both seen to lead to a reduction in marked local forms. To avoid any confusion, I will only, in this discussion, use ‘standardisation’ to refer to convergence in the direction of SF.

5.3.1 MECHANISMS OF LINGUISTIC CHANGE IN THE MID-VOWELS

The SF system distinguishes between two front unrounded mid-vowels, /e/ and /ɛ/, and two back rounded mid-vowels, /o/ and /ɔ/. The front mid-vowels are contrastive in final open syllables in conservative SF while the back mid-vowels are in contrastive distribution in some final closed syllables. In other syllabic contexts, the conformity of the mid-vowel pairs to the *loi de position* varies between the front and back pairs (see Sections 2.2.2.1.3 and 2.5.1).

The northern supralocal system is characterised by a high degree of neutralisation: in non-final open syllables, this is manifested phonetically by a rise in intermediate variants, [ɐ ɛ] and [ɔ ɔ̃], and in final open syllables by neutralisation to a close vowel, [e] or [o]; in (final) closed syllables, the /o/-/ɔ/ distinction is maintained phonetically in some contexts (e.g. *hotte* [ɔt] versus *hôte* [ot]) but the /e/-/ɛ/ distinction is neutralised to [ɛ]. In supralocal French, therefore, the front mid-vowels are not in contrastive distribution in final open syllables but the back mid-vowels are contrastive in some final closed syllables⁴⁰.

In the south of France, for the DSP, there is a neutralisation of SF contrasts in final syllables with the phonetic variants of the /E/ and /O/ mid-vowels governed by a regular *loi de position* (see Section 2.3.1.1): [e] and [o] in open syllables; [ɛ] and [ɔ] in closed syllables. The DSP system differs from that of the supralocal norm as it

⁴⁰ I have previously used the ‘archiphonemic’ symbols, /E/ and /O/, to represent the high levels of variability in the mid-vowels of supralocal French and to distinguish the northern statistical norm from SF (see Section 2.2.2.1.3). The use of the same symbols to describe the DSP pattern and, in particular, the use of /O/ to designate the RF baseline norm for the older speakers should not be taken to mean that these varieties conform to the supralocal French pattern.

is not characterised by the use of intermediate variants in non-final syllables and phonemic contrast in the back mid-vowels is neutralised in final closed syllables.

The accounts in the literature of RF in southwest France (e.g. Carton et al., 1983; Walter, 1982) claim that open variants of the mid-vowels, [ɛ] and [ɔ], are used in all positions, that is, there is neutralisation the SF phonemic contrasts (see Section 2.3.1.1). The analysis of the mid-vowels in Chapter 4, however, revealed the front /e/-/ɛ/ distinction to be maintained by older speakers while in the back of the vowel space, one vowel /O/ was used, which was phonetically realised as a close-mid centralised vowel. There was evidence to suggest, however, some neutralisation of the /e/-/ɛ/ contrast in line with the *loi de position* and contextually conditioned variants of the back mid-vowel, /O/, were shown to conform to the *loi de position* (see Section 5.1.1).

Taking the data from Chapter 4 as a starting point, evidence for the use of DSP variants in RF would indicate that the process of levelling ‘proper’ is active, favouring the adoption of pan-regional forms. Evidence for the use of the SF or supralocal systems in RF would indicate that the linguistic mechanism of diffusion is active in the variety, suggesting that standardisation or supralocalisation are taking place.

In the front of the vowel space, older speakers and the younger speakers make a phonetic distinction between /e/ and /ɛ/. For the former, this involves using variations in vowel height (F1) and for the latter, variations in vowel frontness (F2). The middle generation use a single phonemic category for the front mid-vowels, /E/.

The system used by the older speakers appears to be an instance of standardisation when compared with the traditional southwestern system which uses [ɛ] in all contexts: older speakers make a vowel height distinction between the front mid-vowels, characteristic of the prescriptive norm. Older speakers were, however, also shown to use allophonic variants: close front vowels in open syllables; open centralised vowels in closed syllables. The phonetic distinction between /e/ and /ɛ/ is apparently contradicted by this finding which indicates the neutralisation of contrast in final open syllables. While the *loi de position* was not present in traditional accounts of southwestern RF, we may note that Moreux found evidence for gradual change in the direction of the DSP in the 1980s (see Section 2.3.1.1) and this is consistent with the data presented here for the older generation which appears to show some influence of the DSP.

The middle generation, on the other hand, who neutralise the phonetic contrast between /e/ and /ɛ/, make use of a system common to the DSP and supralocal French: the use of a single phonemic category, /E/, could thus be a result of levelling ‘proper’ (adopting a pan-regional feature) or of geographical diffusion (adopting a supralocal feature), or of both acting in tandem (as in the case of the MOUTH vowel in Milton Keynes; see Section 1.3.1.3). In the middle generation, speakers realise the *loi de position* on the basis of vowel height alone: close vowels in open syllables; open vowels in closed syllables which is, again, consistent with dominant southern and dominant northern norms.

The young generation realise /e/ and /ɛ/ as phonetically different using a front-centralised distinction. Analyses that have examined the mid-vowels in terms of a tense-lax distinction (e.g., Scullen, 1997) have similarly noted that /ɛ/ is

somewhat lowered and retracted when compared to /e/. This is certainly a tendency that was noted in the acoustic analyses of the front mid-vowels presented in this chapter, and in Chapter 4. It appears that younger speakers are implementing the front mid-vowel contrast phonetically in a new way: older speakers use only the open-close distinction while younger speakers use only the front-centralised distinction. Younger speakers in Béarn have not adopted the single phonemic category, /E/, present in the speech of their parents' generation, and therefore their system cannot be said to represent the cumulative effect of an apparent time change. The young generation were shown, however, to use both height and frontness/backness to make a three-way allophonic distinction: close front vowels in final open syllables; close central vowels in medial open syllables; open central vowels in final closed syllables. Again, this contextual conditioning appears to contradict the phonetic distinction between /e/ and /ɛ/ made on the basis of a front-centralised distinction. It appears that young speakers may have adopted the *loi de position* for vowel height, neutralising contrasts between /e/ and /ɛ/ in final open syllables on this dimension, while distinguishing phonetically between these vowels on the front/back dimension. The pattern for young speakers appears to be based on, but distinct from, the two-way allophonic distinction in the system of their grandparents' generation. It is not clear if contact has a role to play in the divergent allophonic variants across the generations and the speech of the younger generation cannot be said to be the result of a linear apparent-time change.

In the back of the vowel space, older and younger speakers use one phonemic category /O/, while middle speakers distinguish between /o/ and /ɔ/ on the basis of

vowel height. For the older generation, the use of a single phonetic category mirrors the system reported in accounts of southwestern RF, where [ɔ] was used in all positions. We may note however that the /O/ of these speakers is close-mid and centralised rather than an open-mid vowel. Three allophonic variants were distinguished phonetically for /O/: close back variants in final open syllables; close central variants in medial open syllables; open back variants in final closed syllables. The divergence between the baseline norm for the older speakers and the traditional southwestern system is consistent with the levelling ‘proper’ which appears to have favoured the adoption of the DSP system, in which the *loi de position* neutralises the SF contrast in final closed syllables. Again, Moreux provided evidence to suggest that this change was under way from as early as the 1980s (see Section 2.3.1.1).

The realisation of a distinction between /o/ and /ɔ/ by the middle generation of speakers is more consistent with diffusion of the standard than with diffusion of the more recent supralocal norm: there is no evidence for the use of intermediate variants in non-final or final open syllables. This, of course, raises the question of why middle speakers have adopted the SF system for the back mid-vowels but the supralocal French system for the front mid-vowels. In the case of the front mid-vowels, the adoption of the northern supralocal norm may have been reinforced by the fact the DSP uses the same system. Indeed, I noted that the use of /E/ by the middle generation may have been a result of both pan-regionalisation and supralocalisation, of levelling ‘proper’ and geographical diffusion acting together. For the back mid-vowels, on the other hand, the absence of such reinforcement, due to the divergence between the supralocal and DSP systems, may have favoured the adoption of the more overtly prestigious SF system. Speakers in the middle

generation were shown, however, to distinguish phonetically between close variants in open syllables and open variants in closed syllables. While the use of the *loi de position* by the middle speakers is in line with the baseline norm (and with the DSP), the phonetic distinction made between the back mid-vowels in different phonological contexts is inconsistent with the phonetic distinction made between /o/ and /ɔ/. Evidence for the use of the *loi de position* may, therefore, indicate a gradual reduction in the phonetic distinction between the /o/ and /ɔ/ in final open syllables rather than a complete phonetic merger (in the direction of the DSP).

The young generation use a similar system to the older generation and do not make a consistent phonetic distinction between /o/ and /ɔ/ in terms of vowel height or vowel frontness/backness. The younger generation use three-way pattern of allophonic variation which mirrors that of the front mid-vowels: close back vowels in final open syllables, close central vowels in medial open syllables; open central vowels in final closed syllables. The only difference between the young speakers' system and that of the older speakers is that the variant used in closed final syllables is open and central for young speakers but open and back for old speakers. The use of a more symmetrical system of allophonic variation in the young generation, for the front and back mid-vowels, may be viewed as a (perhaps innovative) continuum with at least three terms and with final open and final closed allophones as the end-points of such a continuum. Trudgill stipulates that simplification involves the regularisation of allophonic categories, which appears to be the case for younger speakers (see Section 1.3.2). We may note, however, that the system used by the middle generation of speakers is also regular and, indeed, contains less allophonic variants.

Additionally, young speakers were shown to significantly centralise /ɔ/, a well known phenomenon in supralocal French (cf. Martinet, 1945, 1958; Armstrong and Low, 2008). This change cannot be said to be the end-point of linear apparent time change in that the older and middle speakers do not appear to be taking part its adoption (see Table 5.20). Armstrong and Low (2008), working in Roanne, central-eastern France, consider this feature to be diffusing from Paris, having a relatively non-standard status which carries covert, rather than overt, prestige. Armstrong and Low argue that speakers in older generations have not adopted /ɔ/-fronting because they appear to favour the adoption of more well-established supralocal features that carry more overt prestige. The social capital of /ɔ/-fronting appears to have changed, however, from the perspective of younger speakers who engage in this supralocal change via geographical diffusion.

5.3.2 MECHANISMS OF LINGUISTIC CHANGE IN THE NASAL VOWELS

SF distinguishes four nasal vowel phonemes: /ɛ̃/, /œ̃/, /ã/ and /ɔ̃/. The vowel quality for these nasal vowels is open-mid front unrounded [ɛ̃], open-mid front rounded [œ̃], open back unrounded [ã], and open-mid back rounded [ɔ̃], respectively.

The supralocal French system contrasts only three nasal vowels: /ɛ̃/, /ã/ and /ɔ̃/. This is a result of the merger of /ɛ̃/ and /œ̃/ to /ɛ̃/. Hansen also found evidence of a change in progress which saw /ã/ raising to merge with /ɔ̃/, which meant that

the vowels were distinguished on the basis of lip-rounding alone (1998: 11-12). The phonetic realisation of this three-term system in supralocal French corresponds largely to the SF pronunciations: open-mid front unrounded [ɛ̃], open back unrounded [ɑ̃] and open-mid back rounded [ɔ̃], though Hansen (1998) also noted that these three vowels may be involved in a chain shift (from below) in Parisian French: /ɛ̃/→[ɑ̃], /ɑ̃/→[ɔ̃] and /ɔ̃/→[õ].

The DSP was seen to maintain a four-term nasal vowel system: /ɛ̃/, /œ̃/, /ɑ̃/ and /ɔ̃/ which mirrors the system used in SF. The phonetic realisation of the southern French system, however, differs greatly from the SF: nasalisation is variable; vowel quality is traditionally modified such that /ɛ̃/ is higher [ē̃], /ɑ̃/ is central [ā̃] and /ɔ̃/ is more open [ō̃]; nasal consonant codas frequently accompany nasal vowels, e.g. [ē̃N], [œ̃N], [ā̃N] and [ō̃N].

The traditional view of southwestern RF is that it contains four nasal vowel phonemes and that it conforms largely to the DSP (Walter, 1982:182; Carton et al., 1983:61). The baseline norm, established in the language contact study, conformed largely to this traditional system: older RF speakers distinguish between four nasal vowels, with variable vowel quality and variable nasal consonant codas.

From a phonological perspective, the RF of Béarn is stable across the three generations examined in the apparent time study. Each generation maintains a four-term nasal vowel system (/ɛ̃/, /œ̃/, /ɑ̃/, /ɔ̃/). This phonological stability across apparent time has most likely been favoured by levelling ‘proper’: the DSP

traditionally maintains the /*ẽ*/-/œ/ distinction and contact with adjacent varieties would thus have resulted in the retention of the local system by virtue of its association with the pan-regional norm. The four-term system is also, of course, used in SF but these findings appear to be more consistent with levelling ‘proper’ in the direction of the DSP rather than diffusion of SF: the phonetic characteristics of the nasal vowels are more typically southern than standard.

Despite the phonological stability in the nasal vowel system of the RF of Béarn, the apparent-time study revealed various phonetic changes to be taking place in the nasal vowels. /*ẽ*/ was shown to be stable across the generations with no significant phonetic changes taking place. Additionally, /*ẽ*/ was distinguished from /œ/ on the basis of F2 alone which contradicts the traditional assumption that /*ẽ*/ is raised to [ẽ] in southwestern RF. If the traditional accounts were correct, the change from a close-mid to an open-mid vowel may indicate diffusion of the standard or supralocal norm, [ẽ]. Change in apparent time was also shown to be occurring in the other vowels: /œ/-fronting; /ã/-backing; /ɔ/-centralisation.

Significant fronting of /œ/ in apparent time only occurred in non-sequential nasal units when no consonantal coda was present, [œ̃]. This may be interpreted as evidence for geographical diffusion in that the acoustic fronting of [œ̃] would reduce the phonetic difference between (stable) /*ẽ*/ and /œ/. I have argued that sequential units [ṽN] constitute a ‘non-standard’ phonetic environment for the nasal vowels and that non-sequential units [ṽ] are a ‘standard’ or ‘supralocal’ environment. It seems

no coincidence that there is more evidence for a supralocal feature (merger of /*ẽ*/-/*œ*/) in the ‘supralocal’ phonetic environment. It seems plausible, therefore, that the supralocal /*ẽ*/-/*œ*/ merger is taking place gradually in the RF of Béarn with non-sequential phonetic environments leading the change. If this is the case, it is clear that this change has not yet come to completion and that any apparent diffusion of the supralocal norm constitutes a change in progress.

The /*ã*/-backing change may be interpreted as an instance of supralocalisation whereby the traditional centralised variant of the older generation (and of the traditional norm) has been replaced, in apparent time, by a low back variant (approximately [*ã*]) by the mechanism of geographical diffusion. There is no evidence for /*ã*/-raising: the supralocal merger in which /*ã*/ raises to merge with /*õ*/ does not appear to be taking place; the supralocal chain shift where /*ã*/ raises to [*õ*], causing /*õ*/ to raise to [*ö*], is not in evidence either.

/*õ*/-centralisation was revealed in the apparent time study to be a significant change in progress. There is no evidence to suggest that this change is a direct result of either levelling or geographical diffusion in that it is not attested in the DSP or in supralocal French. Martinet (1945; 1958) proposed a functional explanation for oral /*ɔ*/-fronting: the presence of /*ɑ*/ in the speech of northern informants was said to have caused crowding in the back of the vowel space leading to fronter realisations of /*ɔ*/. It is also possible, therefore, that /*ã*/-backing in the RF of Béarn has caused /*õ*/-centralisation to maximise the phonetic distinction between the phonemes and to maintain a four-term nasal vowel system. From a functional perspective, the

significant /œ/-fronting discussed above may also be interpreted as part of a wider systemic change, or chain shift (rather than a case of supralocalisation), as illustrated in Figure 5.33.

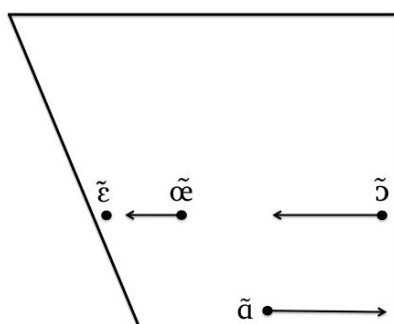


Figure 5.33. Chain shift in the regional French of Béarn

Another explanation is that /õ/-centralisation is occurring by analogy with /ɔ/-fronting. In this case, /õ/-centralisation might be interpreted as an indirect consequence of supralocalisation (given that /ɔ/-fronting is a feature which has been adopted via geographical diffusion of the supralocal northern norm). We must note, however, that old- and middle-generations speakers were not involved in the /ɔ/-fronting change whereas, /õ/-centralisation may accurately be described as a linear change in apparent time: all generations participate in the change with young speakers using the most centralised vowels. This suggests that /õ/-centralisation cannot be occurring by analogy with oral /ɔ/-fronting, at least for the middle and older generations.

Finally, the occurrence of consonantal codas with nasal vowels was shown to be a significant apparent time change in progress: younger speakers use fewer consonantal codas than middle speakers, who use fewer codas than older speakers.

The sequential nasal unit [ṽN] remains, however, the majority variant even in the speech of the young. The reduction in nasal coda use may be interpreted as a case of incipient supralocalisation as a result of the diffusion of the northern norm. The retention of nasal codas as majority variants, on the other hand, appears to indicate pan-regionalisation as a result of levelling ‘proper’ which has favoured the retention of the DSP. The occurrence of nasal consonant codas was shown to be favoured by certain syllable structures, /CṽC#/ and /ṽCV(C)#/, while /Cṽ#/ constituted a less favourable environment for nasal consonants and this phonological conditioning was stable across all generations.

5.4 CHAPTER SUMMARY

The results of the dialect contact study have provided a detailed phonetic and phonological account of the mid- and nasal vowels in the RF of Béarn: synchronic variation was presented for each of the three generations of speakers before examining linguistic change diachronically using an apparent-time methodology. The findings of these synchronic and diachronic analyses were subsequently interpreted with reference to the RDL model: the linguistic outcomes of contact with contiguous and incoming dialects of French were examined in the speech of each generation and over time. This analysis had the aim of identifying and explaining the loss or retention of regional phonetic and phonological features by younger generations, set against the backdrop of the baseline norm for older speakers, established in Chapter 4.

Dialect contact was shown to promote the adoption, into the RF of Béarn, of pan-regional southern features as well as non-local features of the supralocal

northern norm. The linguistic mechanisms of levelling ‘proper’ and geographical diffusion were shown to be active in RF over time, indicating linguistic focusing in contemporary RF, rather than complete convergence towards the supralocal norm. Evidence for spontaneous local developments, which could not be explained directly by the process of RDL, were also presented, indicating innovation rather than obsolescence in RF. Indeed, the complex patterns of convergence towards and divergence from the northern norm indicate that the speech of young Béarn residents cannot be considered to be the result of wholesale dedialectalisation. Conversely, young speakers were shown, in some instances, to use more regional variants than speakers in the middle generation contradicting the assumption that there is a ‘manque de méridionalité’ in the speech of young southerners.

The findings presented in this chapter are discussed with specific reference to the ‘ephemeral’ hypothesis, that RF is short-lived and transitory, in the ‘Discussion and Conclusions’ section.

DISCUSSION AND CONCLUSIONS

« J'entens bien, dist Pantagruel ; tu es
Lymosin, pour tout potaige, et tu veulx icy
contrefaire le Parisian [...] A ceste heure
parle tu naturellement. »

(François Rabelais, *Pantagruel*, 1532)

This thesis has investigated the genesis and evolution of the regional variety of French spoken in Béarn. This investigation considered phonetic and phonological changes taking place in RF in two different contact situations: language contact with Béarnais and dialect contact with other contemporary varieties of French. The language and dialect contact studies have examined two general hypotheses: that RF is a result of ‘substrate residue’ from Béarnais and that this ‘residue’ is ephemeral and will therefore be lost as time advances.

The character of phonetic and phonological change during language contact was discussed with explicit reference to L1-to-L2 linguistic transfer in bilingual speech. The linguistic mechanisms by which transfer occurs were discussed in relation to Flege’s SLM, used hitherto in research on second language acquisition. In this model, equivalence classification of cognate phonemes in a bilingual’s languages is said to promote ‘phonetic category assimilation’ whereby L1 and L2 sounds are stored in the same phonetic category and eventually come to resemble each other in production. If equivalence classification is blocked, however, by new category formation, we saw that a new L2 phonetic category may be formed for L2 sounds: these new categories may subsequently diverge from L1 pronunciations via the mechanism of ‘phonetic category dissimilation’.

When dialects of the same language come into contact, three primary linguistic mechanisms were shown to favour linguistic change: levelling,

geographical diffusion and simplification. These mechanisms were discussed in relation to two models of language change: Kerswill's (2003) 'regional dialect levelling' which comprises levelling 'proper' and geographical diffusion; Trudgill's 'koinéization' which comprises levelling 'proper' and simplification. Levelling 'proper' was shown to act over a relatively compact geographical space, favouring the retention of majority variants between the dialects in contact. Geographical diffusion, on the other hand, was seen to act over a larger geographical space, favouring the adoption into regional varieties of supralocal variants from large, dominant urban centres. The simplification process was seen to promote increases in morphophonemic regularity as a result of dialect mixing.

The sociological and linguistic examination of all varieties of Gallo-Romance spoken in the Béarn region showed Béarnais to be involved in a process of language shift, whereby it has gradually been ousted from all domains by French since as early as the thirteenth century. High levels of active bilingualism were present in the region for a limited period dating from the late nineteenth century until the decades following the Second World War, but since then Béarnais has found itself in a situation of gradual obsolescence at the hands of French, and simultaneously in competition with a standardised variety of *langue d'oc*, Occitan. Importantly, I have argued that the typological distance between Béarnais and French constitutes a language contact situation that is substantially different to that examined in other theoretical analyses of emergent RF (e.g., Hornsby, 2006).

An examination of the phonological systems of Béarnais, Occitan and French in Chapter 2 traced the historical evolution of each language variety from Latin and identified structural cognates in the contemporary Béarnais and French phonologies, that is, those sound units that may be associated by equivalence classification in the

bilinguals' phonological system. The SLM would predict that these would be the Béarnais features which might transfer into French during language contact, potentially resulting in the presence of 'substrate residue' in the RF of bilingual Béarnais-French speakers. In order to be able to evaluate subsequent developments in the RF of younger, monolingual generations, I then presented accounts from the literature of more recent developments in local and supralocal varieties of French. Comparisons were presented between southwestern regional patterns and those common to all southern varieties of French (the DSP), and between the regional patterns and the supralocal French system diffusing from the north. From this comparison, the mid-vowels and nasal vowels emerged as candidates for close analysis as they were shown to differ most dramatically between the southern and northern systems.

The first empirical, sociophonetic study of the thesis, examining language contact, investigated unilateral L1-to-L2 transfer from Béarnais into French by examining the mid-vowels and nasal units of ten bilingual speakers from three fieldwork sites (Chapter 4). This study used a combination of selected Labovian data collection techniques to construct corpora for French and Béarnais and these data were subsequently analysed using acoustic phonetic techniques as well as some impressionistic analysis (e.g., for nasal consonant codas). Examining the applicability of the SLM to the situation of language contact between Béarnais and French allowed this study to test the 'residue' hypothesis but also contributed to research in second language acquisition by providing a new perspective on L1-to-L2 linguistic transfer, considering 'speech learning' in a situation of long-term territorial language contact.

In addition to raising questions about previous analyses of the mid-vowels and nasal units, the language contact study produced interesting findings regarding the linguistic mechanisms active during the emergence of RF from language contact:

(I) Structural disaccord between the languages in contact resulted in the establishment of an analogical L2 (phonemic) category, based on the phonemic category of the L1.

(II) Equivalence classification led to cross-linguistic phonetic category assimilation when the phonemic categories of the L1 and L2 were in one-to-one structural correspondence.

(III) Phonological transfer did not necessarily entail phonetic transfer: the establishment of one L2 phonemic category in RF (which conflates two monolingual L2 categories) by analogy with a single L1 category did not always lead to phonetic category assimilation via equivalence classification.

(IV) New category formation led to the establishment of new L2 phonetic categories in RF when there was structural disaccord or overly complex structural relationships between the corresponding elements of the L1 and L2 phonologies.

(V) Phonetic categories in each of the bilinguals' languages can be constrained by different allophonic rules which do not appear to be involved in transfer.

Finding (I) provides evidence that the phonological categories of emergent RF appear, at least in the early stages of contact, to be based on phonemic categories present in Béarnais. The RF of the older, bilingual speakers was shown to make a distinction between /e/ and /ɛ/ but the distinction between conservative French /o/ and /ɔ/ was not maintained, both French sounds being equated in RF in the same

category, /O/. I argued that the three emergent RF categories, /e/, /ɛ/ and /O/ were equated with the Béarnais phonemic categories, /e/, /ɛ/ and /ɔ/ by equivalence classification. The surface phonologies of Béarnais and French nasal units were shown to exhibit complex structural correspondences and I argued that French /œ/ and /ɔ̃/ were unambiguous phonemic cognates of Béarnais /ỹN/ and /ũN/, respectively. The relationships between the other elements of the French nasal vowel system, /ẽ/ and /ã/, and the remaining Béarnais units, /ĩN, êN, ãN/, were found to be opaque or ambiguous, from an analysis of their surface realisations alone.

Finding (II) shows that the phonetic categories of Béarnais (the actual pronunciations) were transferred into RF if and only if there existed an isomorphic relationship between L1 and L2 structural cognates. This was true primarily of RF /e/ and /ɛ/, which were pronounced in the same way in both Béarnais and RF. For the unambiguous phonemic cognates of the RF nasal vowels, or those that exhibited a one-to-one structural correspondence with historically related Béarnais nasal units, equivalence classification led to varying levels of phonetic category assimilation in RF. For example, RF /œ/ was realised as an instance of the Béarnais [ỹN] phonetic category in sequential units alone: RF [œ̃N] and Béarnais [ỹN] were pronounced the same (and so in Flege's terms they are realisations of the same phonetic category), while RF [œ] and Béarnais [ỹ] were pronounced differently. In this case, it appeared that nasal consonant presence was a complicating factor in the transfer analysis. Additionally, I found evidence that vowel quality in RF /ɔ̃/ was not distinguished phonetically from Béarnais /ũN/ in terms of vowel height, the primary dimension

which distinguishes these vowels in impressionistic terms, but there was also evidence to suggest that these vowels are phonetically distinct on other (F2 and F3) dimensions.

Finding (III) derives from the analysis of RF /O/ which, as indicated by Finding (I), was established as a phonological category by analogy with Béarnais /ɔ/. The status of Béarnais /ɔ/ and French /O/ as a structural equivalence class did not, as predicted by the SLM, lead to phonetic category assimilation: the RF vowel was, in fact, phonetically distinct from Béarnais [ɔ]. It appeared that, while the establishment of a single L2 category for RF was a clear case of phonological transfer, this /O/ category has dispersed in the vowel space, via the linguistic mechanism of phonetic category dissimilation, in order to preserve phonetic contrast with Béarnais [ɔ]. I suggested that this dissimilation was related to the greater range of variability within the French [O] category and the potential relationship between French /O/ and Béarnais /u/, which exhibit a one-to-one structural correspondence, from a historical perspective.

Finding (IV) shows that distinct phonetic categories were established for RF sounds when no one-to-one structural correspondences existed between the L1 and L2 surface phonologies. Such new category formation can, as for French /O/, lead to phonetic category dissimilation whereby RF sounds subsequently disperse in the bilingual vowel space to maximise phonetic contrast with Béarnais phonetic categories. For the RF nasal vowels, the analysis demonstrated that new L2 phonetic categories were established for /ẽ/ and /ã/: on the whole, these sounds were realised

as phonetically distinct from Béarnais [ẽN] and [ãN] (their closest ‘perceptual’ cognates). RF /ẽ/ occurring in phonetically non-sequential units, [ẽ], was realised as an instance of the non-sequential Béarnais /ẽN/ phonetic category, [ẽ]: the RF and Béarnais vowels were identical in production. I have argued that this is a case of under-differentiation, where an L2 sound is equated with the nearest phonetically similar L1 phonetic category but where no one-to-one isomorphic relationship exists between the L1 and L2 sounds from a phonological perspective. Again, the presence of a nasal consonant in the Béarnais and the French nasal units was argued to be a complicating factor in the analysis of L1-to-L2 transfer.

Finally, Finding (V) shows that language-specific allophonic rules constrain the variation in L1, L2 and merged phonetic categories. I argued that the presence of such contextually conditioned variation in each of the bilinguals’ languages may account for some (apparent) phonetic differences between L1 and L2 phonetic categories for which the SLM had predicted phonetic category assimilation. Importantly, contextual conditioning did not appear to be involved in L1-to-L2 transfer with the analysis showing both Béarnais and French to contain different language-internal constraints on allophonic variation.

The findings of the language contact study shed light on the ‘residue’ hypothesis outlined in the introduction to this thesis, that RF is a result of the transfer of substrate features, from obsolescent Béarnais, into French. There is some evidence to support this hypothesis but, crucially, the account of emergent RF phonology presented in this thesis demonstrates that the mechanisms of linguistic transfer involved in the formation of the post-contact variety are far more complex than it would suggest. Indeed, the genesis of RF appears to involve an array of phonetic and

phonological assimilation and dissimilation, comprising both what might be termed linguistic ‘residue’ and linguistic innovation.

Phonemic cognates which bear a one-to-one isomorphic relationship in Béarnais and French were prime candidates for L1-to-L2 transfer: the analysis of vowel quality provided strong evidence to suggest that RF /e/, /ɛ/, /œ/ and /ɔ/ are realised phonetically as instances of their structurally corresponding Béarnais phonetic categories, [e], [ɛ], [ỹN] and [ũN], respectively. This equivalence classification of L2 sounds with L1 phonemic categories, leading to phonetic category assimilation, is clearly a case of phonetic (and phonological) transfer from Béarnais into RF and, thus, constitutes, in very crude terms, ‘ce qui reste du dialecte quand le dialecte a disparu’.

There was ample evidence to suggest, however, that RF sounds have formed new phonetic categories in the bilingual vowel space, thus contradicting the ‘residue’ hypothesis. Transfer from Béarnais into French was shown to be disfavoured when structural correspondences between their respective phonologies were overly complex or when there was no one-to-one correspondence between the elements of their surface phonologies: RF /ẽ/ and /ǣ/ were shown to have formed new phonetic categories, distinct from their (opaque) structural cognates in Béarnais, /iN, ẽN, āN/, and from their nearest ‘perceptually similar’ L1 phonetic categories, [ẽN] and [āN], respectively. The phonetic category assimilation of Béarnais [ẽ] and French [ẽ], via under-differentiation, however, provided additional evidence for ‘residue’ from Béarnais in RF.

Finally, the case of RF /O/ constitutes an example of both phonological ‘residue’ from Béarnais and of genuine phonetic innovation in RF. The conflation of French /o/ and /ɔ/ into one phonemic category, /O/, in RF was, I have argued, an instance of phonological transfer, calqued on Béarnais /ɔ/. The subsequent phonetic category dissimilation of RF [O] from Béarnais [ɔ] means that the RF phonetic category diverges from both the Béarnais pronunciation and from the (hypothetical) monolingual French norm. Therefore, RF /O/ established a previously non-occurring phonetic category which was neither ‘residue’ from Béarnais nor an approximation of the ‘standard’ variety of French: RF [O] is an innovation.

Based on the evidence presented in this thesis, we can conclude that, while RF phonology contains clear cases of ‘residue’ from Béarnais, the formation of RF combines many linguistic transfer mechanisms which depend importantly on the existence of structural correspondences between the underlying and surface phonologies of the languages in contact. The idea of RF as ‘substrate residue’ is not entirely incorrect, as the concrete phonetic evidence has shown, but this oversimplification fails to acknowledge equally robust evidence for phonetic and phonological separation between Béarnais and RF and, indeed, evidence for the use of innovative regional variants that have emerged from contact but which did not involve linguistic transfer in the traditional sense.

The second study of this thesis, on dialect contact, examined change over time in RF using an apparent-time methodology: linguistic mechanisms causing change in the mid- and nasal vowel systems were investigated by comparing three generations of speakers, native to the region of Béarn, including the generation of older, bilinguals.

The data consisted entirely of naturalistic speech collected during sociolinguistic interviews, and the analysis employed an acoustic phonetic methodology, as used in the language contact study. I have argued that changes taking place in RF over time are, at least partially, the result of dialect contact with other contiguous varieties of southern RF and, importantly, with incoming varieties of French from elsewhere. We saw that in the latter half of the twentieth century, large-scale in-migration to Béarn, primarily from the north of France has led to increased contact between RF speakers and migrants who make use of the northern supralocal norm. The linguistic mechanisms causing change were interpreted using primarily the RDL model of language change. The dialect contact study had the following important findings:

(VI) Young speakers clearly retain some regional features in their variety of French while abandoning others in favour of supralocal forms.

(VII) Young speakers have incorporated ‘innovative’ variants into their variety of French which cannot be explained by the process regional dialect levelling.

The retention of regional features was evident in the RF of young speakers who distinguished between the front mid-vowels, did not make a phonetic distinction between the back mid-vowels, followed the *loi de position* for the mid-vowels, and used a four-term nasal vowel system with nasal consonant codas as a majority variant, particularly for /ã/ and /õ/. The retention of southern features has resulted, I argued, from levelling ‘proper’, favouring majority southern (DSP) regional variants. By contrast, the adoption by young speakers of certain features associated with the northern statistical norm suggested that geographical diffusion was also taking place (Finding VI): /ã/-backing and a reduction in the frequency of usage of nasal consonant codas. These clear cases of supralocalisation are also, of course, instances

of standardisation. Other supralocal changes were also identified, such as /ɔ/-fronting: this feature was argued to carry covert prestige and it was noted that the adoption of such forms increases linguistic diversity rather than reducing it (contrary to some narrow definitions of dialect levelling).

I have argued that some new variants in the speech of younger speakers may be classified as ‘innovative’, in the sense that they are spontaneous local developments as opposed to being the result of RDL (Finding VII). For example, young speakers were shown to make use of non-standard forms such as fronted /ɔ̃/ or a front-centralised distinction between /e/ and /ɛ/, rather than one of vowel height. Evidence was presented to suggest that these innovative variants may be internally motivated: from a functional perspective /ɔ̃/-fronting may have been instigated by /ɑ̃/-backing; the front-centralised distinction between /e/ and /ɛ/ appears to be the generalisation of a tense-lax distinction, realised on the basis of both vowel height and vowel frontness, to use vowel frontness alone to distinguish the vowels phonetically.

The patterns of change observed in Chapter 5 across three generations of speakers suggested that some linguistic features present in the RF of the younger generation were not necessarily the result of cumulative change in apparent time. It was clear, particularly in the analysis of the mid-vowels, that:

(VIII) Speakers in the middle generation have adopted more supralocal variants than young speakers.

(IX) Speakers in the middle generation appear to favour the adoption of well-established northern supralocal features which carry overt, rather than covert, prestige.

From an apparent-time perspective, Finding (VIII) suggests, I have argued, that the adoption of some supralocal features is age-graded. I acknowledged the possibility that when the young people leave second-level education (and consequently the semi-rural villages where they live), their social networks may become markedly more diffuse promoting the adoption of more supralocal variants, such as front mid /E/. Young speakers were shown, however, to have already adopted some supralocal features which, with the exception of /ɔ/-fronting, middle speakers were also using. The anomalous behaviour of the middle generation with respect to /ɔ/-fronting is summarised in Finding (IX) and this was explained with reference to its status as a relatively non-standard variant. Armstrong and Low (2008) have argued that the social capital of /ɔ/-fronting has changed from one associated with the urban working classes (of Paris, in particular) to one which signals outward looking ‘modern’ aspirations. Therefore, the middle generation may perhaps associate /ɔ/-fronting with its original working-class origins, disavouring its adoption into their variety of French.

Findings (VI–IX) provide important information on the evolution of RF as it moves through time and comes into contact with other contemporary varieties of the language. The evidence presented in the dialect contact study aimed explicitly to address the ‘ephemeral’ hypothesis, that regional variation in French is transient and that young speakers throughout France are adopting the supralocal northern system. The analysis presented in Chapter 5 identified the mechanisms of linguistic change active in the variety of French spoken in Béarn and demonstrated that the level of conformity to the supralocal norm was not sufficient to confirm Wanner’s claim that ‘déjà les jeunes parlent souvent un français parisien presque parfait’ (1993:81): a

highly significant level of regional phonetic and phonological variants were attested in their speech. The assumption that 21st-century RF is ephemeral is grossly oversimplified. Indeed, Wanner's 'young' informants in Languedoc-Roussillon are now middle-aged and I have provided evidence to suggest that the youth of today use more regional variants in their speech than the youth of the 1990s (their parents). The combination of supralocal and regional elements in the speech of young Béarn residents demonstrates that they are using a system that is neither that of their grandparents nor of the supralocal norm. We can draw parallels here with Watt's young Newcastle speakers who were 'aiming to dispel the "cloth cap and clogs" image' and to 'sound like northerners but *modern* northerners' (1998:7). These speakers are said to achieve this by avoiding variants which they perceive as stereotypically associated with their local roots, while simultaneously using non-standard variants that may be considered non-local from a traditional perspective.

This thesis has challenged two long-standing assumptions about RF by considering variation present in the RF of Béarn to be motivated by both language and dialect contact. The language contact study constituted a novel approach to the analysis of substrate 'residue', examining phonetic and phonological transfer by considering a long-term contact situation within the framework of a well-established model of second language acquisition. This study provides the only systematic and theoretical analysis of RF emerging from contact between French and a variety of southern Gallo-Romance: all variationist studies of the genesis or evolution of RF have thus far considered situations where French was in contact with northern *langue d'oïl* dialects (cf. Pooley, 1996; Hornsby, 2006; Hall, 2008). The dialect contact study of this thesis considered linguistic variation and change to be motivated (primarily) by RDL. My analysis explored convergence towards the supralocal northern norm in a

southern region with distinctive socio-political characteristics, far-removed geographically from the ‘hypercephalic’ centre. The application of a variationist methodology in this context therefore contributes to current debates on the nature of RF but provides a fresh contextual and methodological framework within which to examine the formation and development of RF phonologies.

Emergent RF can be seen to preserve substrate features but must importantly be viewed, from a language contact perspective, as a combination of substrate ‘residue’, new phonetic categories and genuinely innovative forms. As it moves through time, the adoption of supralocal features is not surprising, given the increasing levels of contact between northern and southern populations in the latter half of the twentieth century. This approximation of northern norms cannot, however, be considered as complete convergence. Linguistic homogeneity, motivated by centralising social pressures, appears, at least in the speech of the youngest generation, to be offset by (increasing) linguistic diversity: younger speakers combine innovative regional variants with traditional local and supralocal forms in a previously non-occurring combination of new and old features. In this way, younger generations in Béarn may negotiate conflicting regional and non-local identities by sounding like southerners, but *modern* southerners.

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APPENDICES

APPENDIX 3A - 'CHILDHOOD' CONVERSATIONAL MODULE

1. Quand vous étiez petit(e), c'était comment la vie ici?
2. Aimiez-vous l'école? Pourriez-vous me parler de votre vie scolaire?
3. Où assistiez-vous à l'école?
4. Avez-vous appris le français à l'école?
5. D'où venait l'initiateur (-trice) qui vous a enseigné à l'école primaire?
6. Quel genre de choses appreniez-vous?
7. Parliez-vous le béarnais en famille? Le parliez-vous tous les jours?
8. Parlez-vous le béarnais à vos enfants?
9. Que sont-ils les aspects principaux de la culture béarnaise, d'après vous?

APPENDIX 3B - BÉARNAIS WORDLIST

WORDLIST -TRANSLATION TASK

** CONTEXTS SPECIFIED REFER TO CONTEXTS IN BÉARNAIS 'TARGET' WORDS.

VARIABLE CONTEXT	FRENCH	IPA	TARGET BÉARNAIS	IPA
VARIABLE /e/ - /ɛ/				
/Cv#/	venteux	[vātø]	bentadé	[bēnta'ðe]
	avoir	[avwa:ʁ]	abé	[a'βe]
	attendre	[atādɹ]	aténdɛ	[a'tēnde]
	horloge	[ɔʁlɔ:ʒ]	arrelòdyɛ	[are'lɔd̥jɛ]
	artiste	[aʁtist]	artistɛ	[ar'tiste]
	naître	[nɛtɹ]	bàdɛ	['bade]
	voyager	[vwajaze]	biadyà	[bjɑ'd̥ja]
	croire	[kʁwaʁ]	crédɛ	['krede]
	digérer	[dizɛʁe]	debèrɛ	[de'βɛrɛ]
	écrire	[ekʁiʁ]	escribɛ	[e'skribe]

/vCV(C)#/	tempête	[tãpet]	tempête	[tẽm'pestɔ]
	infirmière	[ẽfĩbmjɛ:ʁ]	infirmière	[ĩfĩr'mjɛrɔ]
	vielle	[vjɛj]	biélhe	['bjɛʎɔ]
	billet	[bijɛ]	bilhété	[bi'ʎetɔ]
	feuille	[føɛj]	hoélhe	['hweʎɔ]
	fenêtre	[f(ə)nɛtʁ]	hièstre	['hjɛstrɔ]
	bouteille	[butɛj]	boutélhe	[bu'teʎɔ]
	là-bas	[labɔ]	acera	[a'sera]
	adresse	[adʁɛs]	adrésse	[a'ðresɔ]
	belle	[bel]	bère	['bɛrɔ]
/CvC#/	juillet	[ʒɥijɛ]	yulhét	[jy'ʎet]
	soleil	[sɔlɛj]	sourélh	[su'reʎ]
	froid	[fʁɔwɔ]	rét	[ret]
	fer	[fɛ:ʁ]	hèr	[hɛr]
	entre	[ãtʁ]	entér	[ẽn'tɛr]
	mercredi	[mɛʁkʁɛdi]	dimers	[di'mɛrs]
	serpent	[sɛʁpã]	sèrp (la)	[sɛrp]
	anglais	[ãglɛ]	anglés	[ãŋ'gles]
	français	[fʁãsɛ]	francés	[frãn'sɛs]
	chinois	[ʃinwɔ]	chinoès	[ʃi'nwɛs]

VARIABLE /ɔ/

/vCV(C)#/	horloge	[ɔʁlɔ:ʒ]	arrelòdyɛ	[are'lɔdʝɛ]
	voiture	[vwatyʁ]	oto	[ɔ'tɔ]
	coûter	[kute]	costa	[kɔs'ta]
	tôt	[to]	de d'ore	[de'dɔrɔ]
	semer	[s(ə)mɛ]	embòbɛ	[ẽm'bɔbe]
	homme	[ɔm]	òmi	['ɔmi]
	autobus	[otɔbys]	otobus	[ɔtɔ'bys]
	oeuvre	[œ:vʁ]	obre	['ɔbrɔ]
	obtenir	[ɔb̥t(ə)nir]	obtiéne	[ɔb'tjene]
	cou	[ku]	coth	[kɔtɕ]
/CvC#/	porc	[pɔ:ʁ]	porc	[pɔrk]
	tort	[tɔ:ʁ]	tort	[tɔrt]
	fort	[fɔ:ʁ]	hort	[hɔrt]
	trop	[tʁɔ]	trop	[trɔp]
	noyau	[nwajɔ]	os	[ɔs]

	noix	[nwa]	esquilhòt	[eski'ʎɔt]
	maïs	[mais]	milhoc	[mi'ʎɔk]
	bâton	[batɔ̃]	barrot	[ba'rɔt]
	fois	[fwɔ]	cop	[kɔp]
	sac	[sak]	sacot	[sa'kɔt]
VARIABLE /iN/				
/Cṽ#/	vin	[vẽ]	bî	[bî]
	matin	[matẽ]	matî	[ma'ti]
	voisin	[vwazẽ]	besî	[be'si]
	train	[tʁẽ]	trî	[trî]
	fin	[fẽ]	fî	[fi]
/ṽCV(C)#/	linge	[lɛ:ʒ]	lînyë	[l'linje]
	farine	[faʁin]	harîe	[ha'rîɔ]
	manger	[mãʒe]	minya	[mĩnja]
	jusqu'à	[ʒyska]	dinque	[dĩŋkɔ]
	infirmière	[ẽfiʁmjɛ:ʁ]	infirmière	[ĩfir'mjɛɔ]
/CṽC#/	vingt	[vẽ]	bint	[bĩnt]
	cinq	[sẽk]	cinc	[sĩŋk]
	chemins	[ʃ(ə)mẽ]	camîs	[ka'mis]
	magasins	[magazẽ]	magasîs	[maʁa'zis]
	lapins	[lapẽ]	lapîs	[la'pis]
VARIABLE /ỹN/				
/Cṽ#/	un	[œ]	û	[ỹ]
	brun	[bʁœ]	brun	[brỹn]
	parfum	[paʁfœ]	pérhum	[p'ɛrhỹm]
	quelqu'un	[kɛʎkœ]	quauqu'û	[kaw'kỹ]
	chacun	[ʃakœ]	cadû	[ka'ðỹ]
/ṽCV(C)#/	ongle	[ɔŋ]	ungle	[ỹŋɡlɔ]
	humble	[œbl]	ùmblë	[l'ỹmble]
	pointe	[pwɛ̃t]	punte	[p'ỹntɔ]
	prune	[pʁỹn]	prûe	[prỹɔ]
	lune	[lyn]	lûe	[l'ỹɔ]
/CṽC#/	lundi	[loɛdi]	dilûs/dilhûs	[di'lỹs/di'ʎỹs]
	bruns	[bʁœ]	bruns	[brỹns]
	parfums	[paʁfœ]	pérhums	[p'ɛrhỹms]
	à jeun	[aʒœn]	déyûs	[d'ɛjỹs]

VARIABLE /ẽN/				
/Cĩ#/	plein	[plẽ]	plê	[plẽ]
	dent	[dã]	dén	[dẽn]
	foin	[fwẽ]	hê	[hẽ]
	toujours	[tuʒu:ʁ]	toustém	[tu'stẽm]
	cent	[sã]	cén	[sẽn]
/ĩCV(C)#/	venteux	[vãtø]	bentadé	[bẽnta'de]
	ventre	[vãtʁ]	béntë	[bẽnte]
	tempête	[tãpet]	tempèste	[tẽm'pestɔ]
	pour	[pu:ʁ]	enta	[ẽn'ta]
	femme	[fam]	hémne	[hẽmno]
/CĩC#/	dans	[dã]	déns/héns	[dẽn/hẽn]
	moins	[mwẽ]	ménch	[mẽnʃ]
	rang	[ʁã]	réc	[rẽŋk]
	temps	[tã]	téms	[tẽms]
	fumier	[fymje]	héms	[hẽms]
VARIABLE /ãN/				
/Cĩ#/	laine	[lẽn]	lâ	[lã]
	an	[ã]	an	[ãn]
	demain	[d(ə)mẽ]	doumâ	[du'mã]
	bien	[bjẽ]	plâ	[plã]
	pain	[pẽ]	pâ	[pã]
/ĩCV(C)#/	chambre	[ʃãbʁ]	crampe	[krãmpɔ]
	banque	[bãk]	banque	[bãŋkɔ]
	cloche	[klɔʃ]	campane	[kãm'panɔ]
	chanter	[ʃãte]	canta	[kãn'ta]
	bercer	[bẽʁse]	manca	[mãŋ'ka]
/CĩC#/	franc	[fɹã]	franc	[frãŋk]
	sang	[sã]	sanc/sang	[sãŋk/sãŋg]
	chiens	[ʃjẽ]	câs	[cãs]
	grands	[gɹã]	grans	[grãns]
	pains	[pẽ]	pâs	[pãs]
VARIABLE /ũN/				
/Cĩ#/	melon	[m(ə)lõ]	meloû	[me'lũ]
	chanson	[ʃãsõ]	cançoû	[kãn'su]
	pont	[põ]	poun	[pũn]

	bon	[bõ]	boû	[bũ]	
	jumeau	[ʒymɔ]	bessoû/mièyoû	[be'sũ/mje'jũ]	
	/ṽCV(C)#/	ronfler	[ʁõf̥le]	[arũŋ'ka]	
	longtemps	[lõtã]	lountéms	[lũn'tẽms]	
	mensonge	[mãsõ:ʒ]	mensounyë	[mẽn'sũnje]	
	nombreux	[nõbʁø]	noumbrous	[nũm'brus]	
	conseiller	[kõseje]	counselha	[kũnse'ʎa]	
	/CṽC#/	bons	[bõ]	boûs	[bũs]
	melons	[m(ə)lõ]	meloûs	[me'lũs]	
	bouchons	[buʃõ]	boussoûs	[bu'sũs]	
	donc	[dõk]	dounc/dinc	[dũŋk]	
	fond	[fõ]	houns/founs	[hũns/fũns]	

Table 3B.1. Béarnais Wordlist Translation Task

APPENDIX 3C - TRANSCRIPTION PROTOCOL

ALL TRANSCRIPTIONS USE THE FOLLOWING ORTHOGRAPHICAL CONVENTIONS:

French: Standard Modern French

Béarnais: *Dictionnaire du béarnais et du gascon modernes* (Palay, 1932).

3C.1. TRANSCRIBING CONVENTIONS

3C.1.1 Assignment of pseudonyms

Pseudonyms were chosen for all speakers that approximated their original name in terms of the first letters of the name.

e.g.	Gérard Depardieu	<i>Grégoire Dubois</i>
	Édith Piaf	<i>Élise Puyau</i>

3C.1.2 Interview Identification

3C.1.2.1 Protocol for beginning of interview

(Place, informant pseudonym, age, initials of informant pseudonym <space> speaker number, initials of other participants <space> speaker number, filename of whole interview, version)

(Speaker I.D. Code)

(Filename)

(Time Stamp - T) – noted every 5-6 lines.

e.g.

Interview Transcript

(Gan, LABARTHETTE_Geneviève, 73, GL [001], DM [1], Interview 1.WAV, Version 1)

(Speaker I.D. Code: A)

(Interview 1.WAV)

Time (T): 0.10

[001] C'est moi- c'est moi qui a de mauvaises ondes? Ah ça marche. **[1] Ça marche, je crois** [001] si jamais **[1] ça marche comme-ça, oui** [001] voilà, oui, bon **[1] donc**

3C.1.2.2 Speaker numbers

Single digits refer to interviewers and other participants. In all interviews in the corpus, DM [1] refers to Damien Mooney. Three-digit numbers refer to informants, corresponding to the sample outlined in Section 3, Chapter 3.

e.g. 001, 010, etc.

3C.1.3 Conventions for oral discourse phenomena

3C.1.3.1 False starts

whole word: “-“

partial word: “--“

3C.1.3.2 Hyphenation

Hyphenate tags:

et-tout-ça

n'est-ce-pas

je-ne-sais-pas

et-tout

comme-ça

eh-oui

ce-genre-de-choses

Hyphenate exclamations and fixed expressions:

à-vrai-dire

à-la-mode

à-la-française

eh-oui!

eh-bon!

eh-bien!

enfin-bref

grâce-à

Hyphenate names of people, places, institutions, songs and games

Université-de-Pau

La-chemin-de-la-mature

Ma-belle-mère

Le-certificat-d'études

Oh-mon-païs

3C.1.3.3 Hesitation words

Exclusively...

Form:

euh

oui

3C.1.3.4 Legal fillers

Exclusively...

Form:

quoi

bah

ben

bé

bon

bon-ben

bon-ben-bref

bref

tu vois

vous voyez

tu-vois-ce-que-je-veux-dire?

tu sais

eh-bien

eh-oui

enfin

alors

allez

genre

style

comme

c'est-à-dire

3C.1.3.5 Pauses

Represented by an ellipsis [...], only used if there is an audible silence.

3C.1.3.6 Direct Quotations

Place in double quotation marks according to Standard French punctuation.

e.g. elle me disait « abise-t à las sèrps! »

3C.2. TRANSCRIBING THE WORDLIST

Time Stamp (T)

#mot : FRENCH-WORD

[001] 'béarnais-word'

Time Stamp (T)

APPENDIX 3D - PRAAT SCRIPT FOR EXTRACTING FORMANT VALUES AND VOWEL DURATION

```
[REDACTED]
```

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

APPENDIX 3E - CODING SCHEMA FOR BÉARNAIS MID-VOWELS

Coding Schema for variable (/E/)

Dependent variables	Formant Frequencies of Vowel (F1, F2, F3)
Number	Continuous Measure
FG 1	Vowel Duration
Number	Continuous Measure
FG 2	Phoneme
E	/e/
EH	/ɛ/
FG 3	Syllable Type
OFS	Final Open Stressed Syllable
OFN	Final Open Unstressed Syllable
CFS	Final Closed Stressed Syllable
OMS	Medial Open Stressed Syllable
OMN	Medial Open Unstressed Syllable

Coding Schema for variable (/ɔ/)

Dependent variables	Formant Frequencies of Vowel (F1, F2, F3)
Number	Continuous Measure
FG 1	Vowel Duration
Number	Continuous Measure
FG 2	Syllable Type
CFS	Final Closed Stressed Syllable
OMS	Medial Open Stressed Syllable
OMN	Medial Open Unstressed Syllable

APPENDIX 3F - CODING SCHEMA FOR BÉARNAIS NASAL UNITS

Coding Schema for variables (/iN/, /ỹn/, /ẽN/, /ãN/, /ũN/)

Dependent variables Formant Frequencies of Vowel (F1, F2, F3)	
Number	Continuous Measure
FG 1	Vowel Duration
Number	Continuous Measure
FG 2	Phoneme
IN	/iN/
YN	/ỹN/
EN	/ẽN/
AN	/ãN/
UN	/ũN/
FG 3	(Nasalisation)
Y	Nasalised
N	Non-nasalised
FG 4	Presence of Nasal Consonant Variant
Y	Nasal Consonant Present
N	No Nasal Consonant Present
FG 5	Nasal Consonant Place of Articulation
N	[n]
M	[m]
NG	[ŋ]
GN	[ɲ]

FG 6	Syllable Type
OFS	Final Open Stressed Syllable
CFS	Final Closed Stressed Syllable
OMS	Medial Open Stressed Syllable
OMN	Medial Open Unstressed Syllable

APPENDIX 3G - CODING SCHEMA FOR FRENCH MID-VOWELS

Coding Schema for variable (/E/)

Dependent variables	Formant Frequencies of Vowel (F1, F2, F3)
Number	Continuous Measure
FG 1	Vowel Duration
Number	Continuous Measure
FG 2	Phoneme
E	/e/
EH	/ɛ/
FG 3	Syllable Type
/Cv#/	Final Open Syllable
/CvC#/	Final Closed Syllable
/vCV(C)#/	Medial Open Syllable

Coding Schema for variable (/O/)

Dependent variables	Formant Frequencies of Vowel (F1, F2, F3)
Number	Continuous Measure
FG 1	Vowel Duration
Number	Continuous Measure
FG 2	Phoneme
O	/o/
OH	/ɔ/
FG 3	Syllable Type
/Cv#/	Final Open Syllable
/CvC#/	Final Closed Syllable
/vCV(C)#/	Medial Open Syllable

APPENDIX 3H - CODING SCHEMA FOR FRENCH NASAL VOWELS

Coding Schema for variables (/ẽ/, /œ/, /ã/, /õ/)

Dependent variables Formant Frequencies of Vowel (F1, F2, F3)	
Number	Continuous Measure
FG 1 Vowel Duration	
Number	Continuous Measure
FG 2 Phoneme	
EN	/ẽ/
OEN	/œ/
AN	/ã/
ON	/õ/
FG 3 Presence of Nasal Consonant	
Y	Nasal Consonant Present
N	No Nasal Consonant Present
FG 4 Nasal Consonant Place of Articulation	
N	[n]
M	[m]
NG	[ŋ]
GN	[ɲ]
FG 5 Syllable Type	
/Cṽ#/	Final Open Syllable
/CṽC#/	Final Closed Syllable
/ṽCV(C)#/	Medial Open Syllable

APPENDIX 4A – MEANS AND STANDARD DEVIATION DATA (CHAPTER 4)

			/e/		/ɛ/	
			μ	σ	μ	σ
F1	Speaker F	◆	521	(36)	614	(66)
	Speaker G	■	444	(35)	553	(83)
	Speaker H	▲	425	(31)	536	(40)
	Speaker I	▪	480	(47)	603	(90)
	Speaker J	●	404	(24)	507	(41)
			μ	σ	μ	σ
F2	Speaker F	◆	1880	(175)	1932	(239)
	Speaker G	■	2208	(125)	1964	(105)
	Speaker H	▲	1900	(140)	1937	(140)
	Speaker I	▪	1963	(104)	1877	(142)
	Speaker J	●	2088	(153)	2028	(176)

Table 4A.1. Male speakers: Mean F1 and F2 values (Hz) and standard deviations for Béarnais front mid-vowels (see Figure 4.3).

			/ɔ/	
			μ	σ
F1	Speaker F	◆	593	(41)
	Speaker G	■	562	(88)
	Speaker H	▲	520	(41)
	Speaker I	▪	588	(35)
	Speaker J	●	496	(40)
			μ	σ
F2	Speaker F	◆	939	(53)
	Speaker G	■	1095	(86)
	Speaker H	▲	959	(83)
	Speaker I	▪	982	(99)
	Speaker J	●	910	(83)

Table 4A.2. Male speakers: Mean F1 and F2 values (Hz) and standard deviations for the Béarnais back mid-vowel (see Figure 4.3).

			/e/		/ɛ/	
			μ	σ	μ	σ
F1	Speaker A	◆	575	(109)	697	(126)
	Speaker B	■	465	(23)	539	(112)
	Speaker C	▲	463	(30)	541	(55)
	Speaker D	▪	493	(44)	548	(130)
	Speaker E	●	442	(81)	531	(67)
			μ	σ	μ	σ
F2	Speaker A	◆	2392	(180)	2213	(267)
	Speaker B	■	2105	(144)	2051	(107)
	Speaker C	▲	2089	(161)	2015	(116)
	Speaker D	▪	2289	(136)	2017	(105)
	Speaker E	●	2411	(353)	2081	(223)

Table 4A.3. Female speakers: Mean F1 and F2 values (Hz) with standard deviations for Béarnais mid-vowels (see Figure 4.5).

/ɔ/				
			μ	σ
F1	Speaker A	◆	691	(95)
	Speaker B	■	548	(83)
	Speaker C	▲	549	(32)
	Speaker D	▪	612	(60)
	Speaker E	●	502	(56)
			μ	σ
F2	Speaker A	◆	1060	(112)
	Speaker B	■	1153	(97)
	Speaker C	▲	1063	(87)
	Speaker D	▪	1237	(191)
	Speaker E	●	1099	(196)

Table 4A.4. Female speakers: Mean F1 and F2 values (Hz) and standard deviations for the Béarnais back mid-vowel (see Figure 4.5).

			(iN)		(ỹN)		(ẽN)		(ãN)		(ũN)	
			[iN]	[ĩN]	[yN]	[ỹN]	[eN]	[ẽN]	[aN]	[ãN]	[uN]	[ũN]
			μ	μ	μ	μ	μ	μ	μ	μ	μ	μ
			σ	σ	σ	σ	σ	σ	σ	σ	σ	σ
F1	Speaker_F	◆	376	511	402	350	529	538	758	ND	463	520
			78	-	64	-	24	20	53	-	50	-
	Speaker_G	■	347	326	362	ND	472	494	804	ND	368	435
			30	40	25	-	52	37	119	-	29	-
	Speaker_H	▲	312	ND	328	349	437	463	659	573	373	ND
			13	-	21	17	30	11	36	-	51	-
	Speaker_I	▪	364	346	378	ND	484	515	659	667	384	ND
F2	Speaker_J	●	-	64	21	-	48	46	52	-	36	-
			ND	331	330	ND	409	428	605	ND	348	ND
			-	12	16	-	30	48	26	-	26	-
	Speaker_F	◆	2305	2485	1790	1734	1926	2086	1294	ND	868	853
			119	-	67	-	188	54	67	-	140	-
	Speaker_G	■	2562	2591	1834	ND	2126	2386	1462	ND	960	1189
			111	185	123	-	149	40	61	-	185	-
F2	Speaker_H	▲	2119	ND	1806	1833	1822	1834	1149	1024	909	ND
			81	-	73	107	128	37	132	-	78	-
	Speaker_I	▪	2121	2179	1596	ND	1935	1887	1480	1460	848	ND
			-	233	95	-	59	91	121	-	109	-
	Speaker_J	●	ND	2401	1689	ND	2001	2070	1492	ND	843	ND
			-	119	120	-	114	65	87	-	217	-
			-	119	120	-	114	65	87	-	217	-

Table 4A.5. Male speakers: Mean F1 and F2 values (Hz) and standard deviations for Béarnais nasalised and non-nasalised vowels in sequential (ỹN) nasal units (see Figure 4.8). (ND = no data available).

			(i)		(ȳ)		(ě)		(ā)		(ū)	
			[i]	[ĩ]	[y]	[ȳ]	[e]	[ě]	[a]	[ā]	[u]	[ū]
			μ	μ	μ	μ	μ	μ	μ	μ	μ	μ
			σ	σ	σ	σ	σ	σ	σ	σ	σ	σ
F1	Speaker_F	◆	436	ND	382	277	ND	526	775	780	382	ND
			71	-	43	25	-	9	69	-	45	-
	Speaker_G	■	365	380	358	ND	379	475	878	907	352	360
			59	37	72	-	-	-	19	69	25	41
	Speaker_H	▲	307	324	313	271	ND	385	742	634	300	302
			58	39	17	44	-	51	-	40	32	-
	Speaker_I	▪	340	343	340	371	ND	430	690	678	395	ND
			31	26	25	35	-	5	-	17	13	-
	Speaker_J	●	364	326	300	291	ND	382	ND	611	326	303
			101	17	16	7	-	-	-	49	18	42
	Speaker_F	◆	2302	ND	1812	1824	ND	2227	1172	1207	678	ND
			232	-	12	116	-	227	37	-	52	-
F2	Speaker_G	■	2769	2454	1822	ND	2399	2351	1391	1340	926	817
			67	42	108	-	-	-	124	68	78	209
	Speaker_H	▲	2135	2230	1849	1848	ND	1883	1186	1242	752	635
			39	131	72	50	-	135	-	190	92	-
	Speaker_I	▪	2346	2355	1714	1741	ND	2246	1297	1459	912	ND
			64	33	106	60	-	153	-	97	109	-
	Speaker_J	●	2465	2454	1667	1724	ND	2294	ND	1515	811	723
			129	67	113	69	-	-	-	161	196	12

Table 4A.6. Male speakers: Mean F1 and F2 values (Hz) and standard deviations for Béarnais nasalised and non-nasalised vowels in non-sequential (ȳ) nasal units (see Figure 4.10). (ND = no data available).

			(iN)		(ȳN)		(ěN)		(āN)		(ūN)	
			[iN]	[ĩN]	[yN]	[ȳN]	[eN]	[ěN]	[aN]	[āN]	[uN]	[ūN]
			μ	μ	μ	μ	μ	μ	μ	μ	μ	μ
			σ	σ	σ	σ	σ	σ	σ	σ	σ	σ
F1	Speaker_A	◆	391	433	479	389	565	ND	892	884	391	591
			16	36	112	-	70	-	81	-	28	-
	Speaker_B	■	331	400	422	470	479	517	780	823	401	382
			86	33	27	-	86	-	60	27	12	17
	Speaker_C	▲	387	377	402	358	483	515	752	ND	389	ND
			25	81	25	62	42	-	62	-	69	-
	Speaker_D	▪	437	446	441	383	528	482	722	ND	339	ND
			9	66	16	-	70	109	42	-	22	-
	Speaker_E	●	330	325	371	ND	386	408	711	ND	362	ND
			41	-	52	-	39	12	137	-	49	-
	Speaker_A	◆	2736	2697	2090	1762	2331	ND	1644	1794	858	1196
			54	549	77	-	148	-	93	-	103	-
F2	Speaker_B	■	2603	2577	1940	2057	2111	1973	1581	1534	1063	814
			187	47	105	-	175	-	120	76	68	347
	Speaker_C	▲	2139	2495	1712	1878	2160	2212	1525	ND	1024	ND
			180	146	106	106	134	-	86	-	67	-
	Speaker_D	▪	2360	2399	2012	1785	2168	2183	1721	ND	743	ND
			175	164	116	-	62	12	106	-	59	-
	Speaker_E	●	2592	2601	1915	ND	2246	2242	1580	ND	724	ND
			219	-	231	-	59	214	156	-	155	-

Table 4A.7. Female speakers: Mean F1 and F2 values (Hz) and standard deviations for Béarnais nasalised and non-nasalised vowels in sequential (ȳN) nasal units (see Figure 4.12). (ND = no data available).

			(i)		(ȳ)		(ē)		(ā)		(ū)	
			[i]	[ĩ]	[y]	[ȳ]	[e]	[ē]	[a]	[ā]	[u]	[ū]
			μ σ	μ σ	μ σ	μ σ	μ σ	μ σ	μ σ	μ σ	μ σ	μ σ
F1	Speaker_A	◆	478	389	473	393	ND	563	ND	848	375	392
			113	16	49	45	-	-	-	83	48	26
	Speaker_B	■	378	364	420	396	422	413	895	911	393	ND
			23	2	29	43	-	-	89	-	26	-
	Speaker_C	▲	409	403	376	ND	455	ND	860	613	399	314
			37	-	46	-	98	-	45	-	83	-
	Speaker_D	▪	428	ND	419	ND	ND	446	777	734	374	415
			26	-	11	-	-	1	5	30	27	104
	Speaker_E	●	306	347	379	367	ND	320	594	651	381	331
			-	44	39	63	-	-	112	72	12	4
F2	Speaker_A	◆	2792	2631	2278	2006	ND	2323	ND	1704	860	902
			117	59	200	142	-	-	-	141	104	58
	Speaker_B	■	2729	2616	1872	1792	2418	2215	1584	1524	1002	ND
			163	28	61	379	-	-	120	-	165	-
	Speaker_C	▲	2553	2418	1781	ND	2179	ND	1498	1350	929	933
			124	-	130	-	165	-	87	-	116	-
	Speaker_D	▪	2467	ND	2011	ND	ND	2383	1709	1650	707	663
			45	-	127	-	-	65	58	129	64	72
	Speaker_E	●	2530	2583	2053	2237	ND	2270	1388	1612	824	657
			-	224	252	29	-	-	151	76	162	29

Table 4A.8. Female speakers: Mean F1 and F2 values (Hz) and standard deviations for Béarnais nasalised and non-nasalised vowels in non-sequential (ȳ) nasal units (see Figure 4.14). (ND = no data available).

		[ĩN]	[ȳN]	[ūN]
		μ σ	μ σ	μ σ
F	◆	3190	2305	2057
		75	86	176
G	■	3375	2634	2367
		256	93	359
H	▲	3043	2980	2199
		48	116	254
I	▪	2729	2382	2406
		71	196	204
J	●	3721	2229	2164
		252	66	163

Table 4A.9. Male Speakers: Mean F3 means and standard deviations for sequential nasal units (see Figure 4.15).

		[ĩ]	[ȳ]	[ū]
		μ σ	μ σ	μ σ
F	◆	3093	2311	2326
		113	164	123
G	■	3426	2658	2443
		276	67	273
H	▲	3087	3002	2089
		62	187	137
I	▪	2903	2409	2506
		159	139	90
J	●	3506	2257	2225
		302	86	276

Table 4A.10. Male speakers: Mean F3 means and standard deviations for non-sequential nasal units (see Figure 4.16).

		[iN]	[ȳN]	[ūN]
		μ σ	μ σ	μ σ
A	◆	3794 401	2950 58	2776 371
B	■	3295 126	2682 116	2230 191
C	▲	3306 257	2420 112	2769 278
D	▪	3113 58	2510 77	2152 221
E	●	3523 218	2802 202	1976 238

Table 4A.11. Female speakers: Mean F3 means and standard deviations for sequential nasal units (see Figure 4.17).

		[i]	[ȳ]	[ū]
		μ σ	μ σ	μ σ
A	◆	3957 285	2833 301	2731 315
B	■	3800 436	2669 201	2822 265
C	▲	3231 220	2488 218	2732 122
D	▪	3334 154	2637 135	2315 170
E	●	3418 286	2788 91	2189 324

Table 4A.12. Female speakers: Mean F3 means and standard deviations for non-sequential nasal units (see Figure 4.18).

			/e/		/ɛ/	
			μ	σ	μ	σ
F1	Speaker F	◆	497	(51)	620	(65)
	Speaker G	■	414	(45)	464	(81)
	Speaker H	▲	400	(34)	471	(45)
	Speaker I	▪	441	(45)	519	(65)
	Speaker J	●	405	(37)	458	(61)
			μ	σ	μ	σ
F2	Speaker F	◆	1721	(208)	1700	(166)
	Speaker G	■	2137	(164)	1910	(234)
	Speaker H	▲	1759	(167)	1664	(118)
	Speaker I	▪	1880	(154)	1781	(162)
	Speaker J	●	1797	(155)	1876	(162)

Table 4A.13. Male Speakers: Mean F1 and F2 values (Hz) and standard deviations for French front mid-vowels (see Figure 4.21).

			/o/		/ɔ/	
			μ	σ	μ	σ
F1	Speaker F	◆	556	(55)	547	(46)
	Speaker G	■	398	(51)	382	(86)
	Speaker H	▲	391	(71)	444	(49)
	Speaker I	▪	462	(51)	467	(59)
	Speaker J	●	407	(45)	482	(60)
			μ	σ	μ	σ
F2	Speaker F	◆	928	(101)	1021	(172)
	Speaker G	■	987	(253)	1058	(124)
	Speaker H	▲	880	(244)	911	(120)
	Speaker I	▪	970	(166)	967	(149)
	Speaker J	●	854	(234)	981	(233)

Table 4A.14. Male speakers: Mean F1 and F2 values (Hz) and standard deviations for the French back mid-vowels (see Figure 4.21).

			/e/		/ɛ/	
			μ	σ	μ	σ
F1	Speaker A	◆	501	(87)	618	(147)
	Speaker B	■	431	(43)	499	(91)
	Speaker C	▲	469	(59)	522	(83)
	Speaker D	▪	465	(49)	537	(112)
	Speaker E	●	388	(134)	493	(132)
			μ	σ	μ	σ
F2	Speaker A	◆	2018	(331)	2037	(266)
	Speaker B	■	2065	(205)	1950	(199)
	Speaker C	▲	2170	(220)	1964	(213)
	Speaker D	▪	2215	(260)	2006	(220)
	Speaker E	●	2396	(340)	2216	(354)

Table 4A.15. Female Speakers: Mean F1 and F2 values (Hz) and standard deviations for French front mid-vowels (see Figure 4.23).

			/o/		/ɔ/	
			μ	σ	μ	σ
F1	Speaker A	◆	498	(102)	642	(112)
	Speaker B	■	446	(49)	466	(62)
	Speaker C	▲	461	(68)	496	(60)
	Speaker D	▪	474	(106)	587	(97)
	Speaker E	●	421	(76)	459	(77)
			μ	σ	μ	σ
F2	Speaker A	◆	1015	(186)	1121	(146)
	Speaker B	■	1110	(150)	1092	(83)
	Speaker C	▲	1044	(249)	984	(152)
	Speaker D	▪	1041	(239)	1176	(156)
	Speaker E	●	1278	(275)	1177	(270)

Table 4A.16. Female speakers: Mean F1 and F2 values (Hz) and standard deviations for the French back mid-vowels (see Figure 4.23).

			[ɛ̃N]	[œ̃N]	[ɑ̃N]	[ɔ̃N]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker F	◆	584 60	556 46	725 75	591 54
	Speaker G	■	454 43	411 45	596 113	443 42
	Speaker H	▲	458 47	443 45	577 54	452 45
	Speaker I	▪	516 47	481 46	598 50	481 55
	Speaker J	●	457 31	439 62	551 41	466 35
	Speaker F	◆	1672 133	1313 160	1287 132	959 111
F2	Speaker G	■	1928 260	1417 346	1322 147	965 124
	Speaker H	▲	1566 194	1175 162	1292 143	957 187
	Speaker I	▪	1720 146	1284 180	1298 220	958 165
	Speaker J	●	1669 261	1565 244	1358 245	936 183

Table 4A.17. Male speakers: Mean F1 and F2 values (Hz) and standard deviations for French vowels in sequential [ṽN] nasal units (see Figure 4.26).

			[ɛ̃]	[œ̃]	[ɑ̃]	[ɔ̃]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker F	◆	541 47	ND -	675 155	560 68
	Speaker G	■	451 64	474 11	580 98	427 69
	Speaker H	▲	481 46	ND -	532 -	ND -
	Speaker I	▪	512 66	424 -	523 66	544 59
	Speaker J	●	449 42	407 -	533 -	ND -
	Speaker F	◆	1714 86	ND -	1254 234	955 49
F2	Speaker G	■	1990 208	1573 147	1394 153	1021 123
	Speaker H	▲	1775 60	ND -	1346 -	ND -
	Speaker I	▪	1790 109	1479 -	1049 119	969 257
	Speaker J	●	1870 105	1471 -	1513 -	ND -

Table 4A.18. Male speakers: Mean F1 and F2 values (Hz) and standard deviations for French vowels in non-sequential [ṽ] nasal units (see Figure 4.28). (ND = no data available).

			[ɛ̃N]	[œ̃N]	[ãN]	[õN]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker A	◆	651 87	565 164	771 84	598 123
	Speaker B	■	436 51	450 67	602 225	502 95
	Speaker C	▲	575 81	572 105	725 106	578 99
	Speaker D	▪	561 77	553 132	686 163	518 84
	Speaker E	●	463 136	417 121	586 120	430 112
F2	Speaker A	◆	1913 168	1848 327	1526 204	1106 163
	Speaker B	■	1751 277	1479 218	1305 139	1126 131
	Speaker C	▲	1973 234	1551 137	1371 117	1053 173
	Speaker D	▪	2084 204	1782 208	1717 165	1142 285
	Speaker E	●	2285 302	1835 280	1513 305	1318 222

Table 4A.19. Female speakers: Mean F1 and F2 values (Hz) and standard deviations for French vowels in sequential [ṽN] nasal units (see Figure 4.30).

			[ɛ̃]	[œ̃]	[ã]	[õ]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker A	◆	720 96	677 81	791 105	705 131
	Speaker B	■	461 75	403 14	570 206	499 130
	Speaker C	▲	561 89	597 72	652 126	526 93
	Speaker D	▪	555 94	502 60	707 66	543 80
	Speaker E	●	609 155	445 169	602 139	430 147
F2	Speaker A	◆	1996 236	1618 246	1467 189	1158 193
	Speaker B	■	1808 170	1358 177	1260 135	1194 74
	Speaker C	▲	1883 97	1577 143	1397 94	1178 153
	Speaker D	▪	2058 123	1814 29	1686 156	1208 213
	Speaker E	●	2468 81	1739 105	1467 412	1257 424

Table 4A.20. Female speakers: Mean F1 and F2 values (Hz) and standard deviations for French vowels in non-sequential (ṽ) nasal units (see Figure 4.32).

		[ɛ̃N]	[œ̃N]
		μ σ	μ σ
F	◆	2604 364	2196 287
G	■	2831 165	2615 186
H	▲	2384 258	2165 243
I	▪	2607 199	2443 107
J	●	2461 401	2559 507

Table 4A.21. Male speakers: Mean F3 values and standard deviations for sequential nasal units (see Figure 4.33).

		[ɛ̃]	[œ̃]
		μ σ	μ σ
F	◆	2662 159	ND -
G	■	2793 412	2876 239
H	▲	2581 360	2030 -
I	▪	2483 300	2382 -
J	●	2739 363	2586 -

Table 4A.22. Male speakers: Mean F3 values and standard deviations for non-sequential nasal units (see Figure 4.34).

		[ɛ̃N]	[œ̃N]
		μ σ	μ σ
A	◆	3142 434	3044 226
B	■	3076 216	3086 191
C	▲	2833 205	2907 139
D	▪	2758 437	2567 322
E	●	3331 364	3096 303

Table 4A.23. Female speakers: Mean F3 values and standard deviations for sequential nasal units (see Figure 4.35).

		[ɛ̃]	[œ̃]
		μ σ	μ σ
A	◆	2975 579	3178 178
B	■	3122 301	3144 294
C	▲	2881 263	2824 232
D	▪	2761 395	2396 35
E	●	3382 275	3383 -

Table 4A.24. Female speakers: Mean F3 values and standard deviations for non-sequential nasal units (see Figure 4.36).

		[ãN]	[õN]
		μ σ	μ σ
F	◆	2322 254	2221 312
G	■	2704 193	2704 172
H	▲	2304 313	2345 343
I	▪	2380 196	2435 182
J	●	2487 526	2288 206

Table 4A.25. Male speakers: Mean F3 values and standard deviations for sequential nasal units (see Figure 4.37).

		[ã]	[õ]
		μ σ	μ σ
F	◆	2204 266	1997 235
G	■	2682 379	2612 186
H	▲	2147 -	ND -
I	▪	2234 136	2410 210
J	●	2297 -	ND -

Table 4A.26. Male speakers: Mean F3 values and standard deviations for non-sequential nasal units (see Figure 4.38).

		[ãN]	[õN]
		μ σ	μ σ
A	◆	3044 490	3068 493
B	■	3133 383	3219 309
C	▲	2834 504	3034 222
D	▪	2582 407	2520 206
E	●	3257 275	3151 498

Table 4A.27. Female speakers: Mean F3 values and standard deviations for sequential nasal units (see Figure 4.39).

		[ã]	[õ]
		μ σ	μ σ
A	◆	3302 335	2955 495
B	■	3220 293	3335 257
C	▲	3021 273	2897 288
D	▪	2742 233	2509 318
E	●	3224 424	2934 447

Table 4A.28. Female speakers: Mean F3 values and standard deviations for non-sequential nasal units (see Figure 4.40).

APPENDIX 4B – FRENCH FRONT MID-VOWELS

Dependent variable = F1 N = 225 Grand mean = 0.123		Deviance: 284 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C v C#/ 	0.542	72	1.87e-13
	/v C V(C)#/ 	-0.222	73	
	/C v #/ 	-0.320	80	
Phoneme	/ɛ/ 	0.115	114	0.0189
	/e/ 	-0.115	111	
Non-significant factor groups were F2 (p=0.648), Lexical frequency (p=0.754)				

Table 4B.1. Male speakers: Results of mixed-effects linear regression for F1 in the front mid-vowels.

Dependent variable = F1 N = 217 Grand mean = 0.066		Deviance: 435 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/C v C#/	0.581	72	2.94e-08
	/v C V(C)#/	-0.235	67	
	/C v #/	-0.346	78	
F2	Continuous variable	0.261	217	0.00312
Phoneme	/ɛ/	132	0.13	0.0315
	/e/	85	-0.13	
Non-significant factor groups were Lexical frequency (p=0.136)				

Table 4B.2. Female speakers: Results of mixed-effects linear regression for F1 in the front mid-vowels.

Dependent variable = F2 N = 225 Grand mean = 0.814	Deviance: 278 Degrees of freedom: 9
Non-significant factor groups were Lexical frequency (p=0.0903), Syllable type (p=0.0913), F1 (p=0.571), and Phoneme (p=0.806).	

Table 4B.3. Male speakers: Results of mixed-effects linear regression for F2 in the front mid-vowels.

Dependent variable = F2 N = 217 Grand mean = 0.754		Deviance: 324 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/Cv#/	0.216	78	4.91e-06
	/vCV(C)#/	0.120	67	
	/CvC#/	-0.336	72	
F1	Continuous variable	0.147	217	0.00611
Non-significant factor groups were Lexical frequency (p=0.927) and Phoneme (p=0.952)				

Table 4B.4. Female speakers: Results of mixed-effects linear regression for F2 in the front mid-vowels.

APPENDIX 4C – FRENCH BACK MID-VOWELS

Dependent variable = F1 N = 214 Grand mean = 0.007		Deviance: 318 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F2	Continuous variable	0.503	214	1.57e-10
Syllable type	/C v C#/	0.492	76	1.78e-09
	/v C V(C)#/	-0.215	72	
	/C v #/	-0.277	66	
Non-significant factor groups were Lexical frequency (p=0.0584) and Phoneme (p=0.3)				

Table 4C.1. Male speakers: Results of mixed-effects linear regression for F1 in the back mid-vowels.

Dependent variable = F1 N = 218 Grand mean = -0.091		Deviance: 381 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
Syllable type	/CvC#/ 	0.532	74	6.5e-12
	/Cv#/ 	-0.209	69	
	/vCV(C)#/ 	-0.322	75	
F2	Continuous variable	0.302	218	7.64e-05
Non-significant factor groups were Phoneme (p=0.194) and Lexical frequency (p=0.401)				

Table 4C.2. Female speakers: Results of mixed-effects linear regression for F1 in the back mid-vowels.

Dependent variable = F2 N = 214 Grand mean = -0.894		Deviance: 248 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.334	214	2.18e-09
Syllable type	/vCV(C)#/ 	0.211	72	9.84e-05
	/Cv#/ 	-0.066	66	
	/CvC#/ 	-0.145	76	
Lexical frequency	Continuous (log-transformed)	0.098	214	0.0159
Non-significant factor groups were Phoneme (p=0.935)				

Table 4C.3. Male speakers: Results of mixed-effects linear regression for F2 in the back mid-vowels.

Dependent variable = F2 N = 218 Grand mean = -0.885		Deviance: 319 Degrees of freedom: 9		
Factor Group	Factor	Coeff.	N	P-value
F1	Continuous variable	0.239	218	4.71e-05
Syllable type	/vCV(C)#/	0.159	75	0.00498
	/CvC#/	0.000	74	
	/Cv#/	-0.159	69	
Non-significant factor groups were Phoneme (p=0.106) and Lexical frequency (p=0.508)				

Table 4C.4. Female speakers: Results of mixed-effects linear regression for F2 in the back mid-vowels.

APPENDIX 4D – MID-VOWELS TRANSFER

Dependent variable = F1 N = 238 Grand mean = -1.035	Deviance: 406 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.843) and Speaker sex (p=0.0544).	

Table 4D.1. All speakers: Regression analysis for /i/: F1 values from Béarnais and French.

Dependent variable = F2 N = 238 Grand mean = 1.132	Deviance: 525 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.777) and Speaker sex (p=0.512).	

Table 4D.2. All speakers: Regression analysis for /i/: F2 values from Béarnais and French.

Dependent variable = F1 N = 242 Grand mean = 1.608	Deviance: 553 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.168) and Speaker sex (p=0.761).	

Table 4D.3. All speakers: Regression analysis for /a/: F1 values from Béarnais and French.

Dependent variable = F2 N = 242 Grand mean = -0.149		Deviance: 228 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Sex	Male	-0.079	125	0.00941
	Female	0.079	117	
Non-significant factor groups were Language (p=0.386).				

Table 4D.4. All speakers: Regression analysis for /a/: F2 values from Béarnais and French.

Dependent variable = F1 N = 229 Grand mean = -0.853		Deviance: 338 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Sex	Male	-0.126	115	0.011
	Female	0.126	114	
Non-significant factor groups were Language (p=0.0707).				

Table 4D.5. All speakers: Regression analysis for /u/: F1 values from Béarnais and French.

Dependent variable = F2 N = 229 Grand mean = -0.909	Deviance: 425 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.31) and Speaker sex (p=0.673).	

Table 4D.6. All speakers: Regression analysis for /u/: F2 values from Béarnais and French.

Dependent variable = F1 N = 299 Grand mean = 0.29		Deviance: 541 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	0.106	144	0.0493
	French	-0.106	155	
Non-significant factor groups were Speaker sex (p=0.725).				

Table 4D.7. All speakers: Regression analysis for /ɔ/: F1 values from Béarnais and French.

Dependent variable = F2 N = 299 Grand mean = -0.988		Deviance: 203 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.131	144	3.34e-05
	French	0.131	155	
Non-significant factor groups were Speaker sex (p=0.348).				

Table 4D.8. All speakers: Regression analysis for /ɔ/: F2 values from Béarnais and French.

Dependent variable = F1 N = 421 Grand mean = 0.022		Deviance: 736 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	0.28	144	7.41e-08
	French	-0.28	277	
Sex	Male	0.069	194	0.036
	Female	-0.069	227	

Table 4D.9. All speakers: Regression analysis for /ɔ/: F1 values from Béarnais (/ɔ/) and French (/o/).

Dependent variable = F2 N = 421 Grand mean = -0.973		Deviance: 544 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Language	Béarnais	-0.087	144	0.0159
	French	0.087	277	
Non-significant factor groups were Speaker sex (p=0.298).				

Table 4D.10. All speakers: Regression analysis for /ɔ/: F2 values from Béarnais (/ɔ/) and French (/o/).

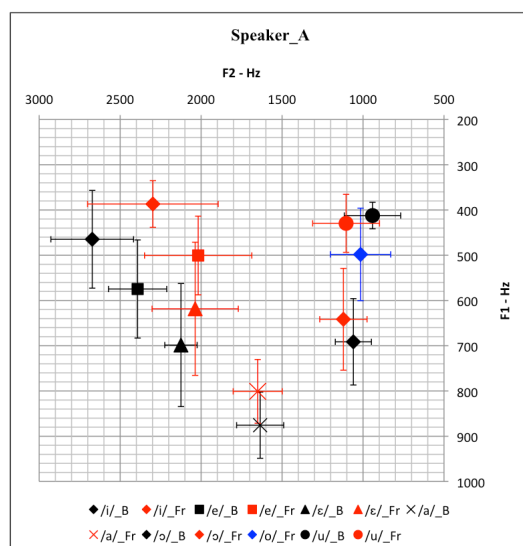


Figure 4D.1. Speaker_A: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

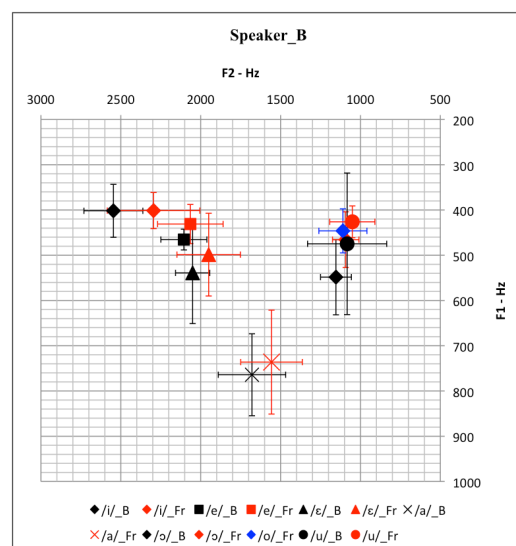


Figure 4D.2. Speaker_B: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

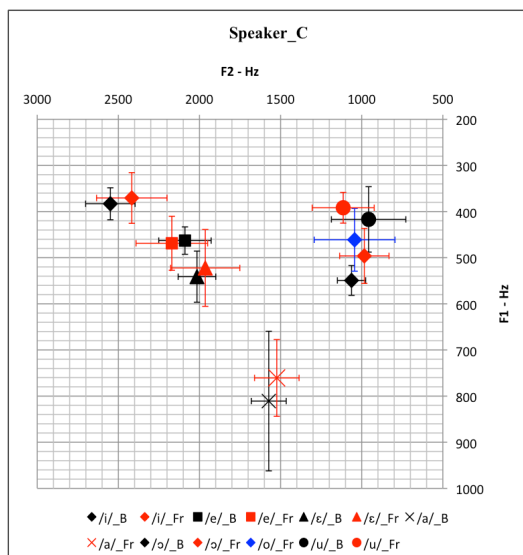


Figure 4D.3. Speaker_C: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

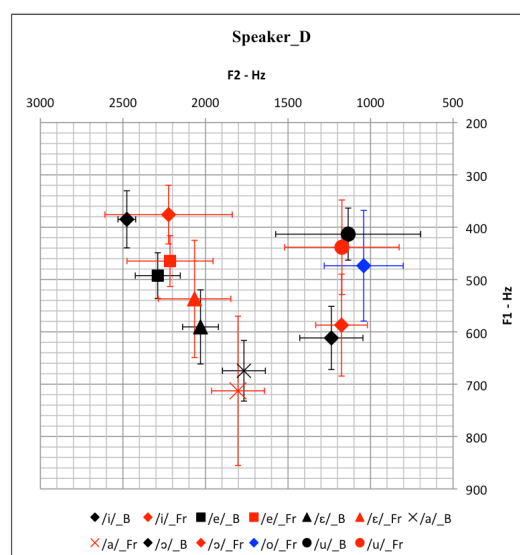


Figure 4D.4. Speaker_D: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

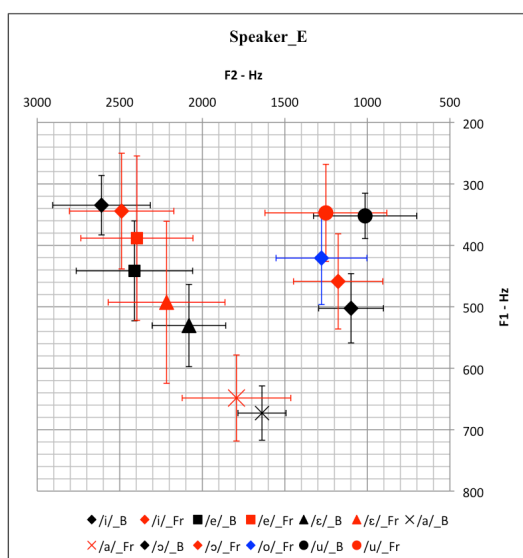


Figure 4D.5. Speaker_E: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

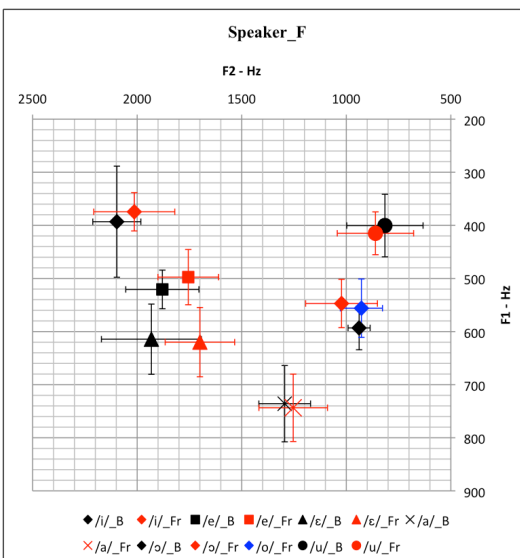


Figure 4D.6. Speaker_F: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

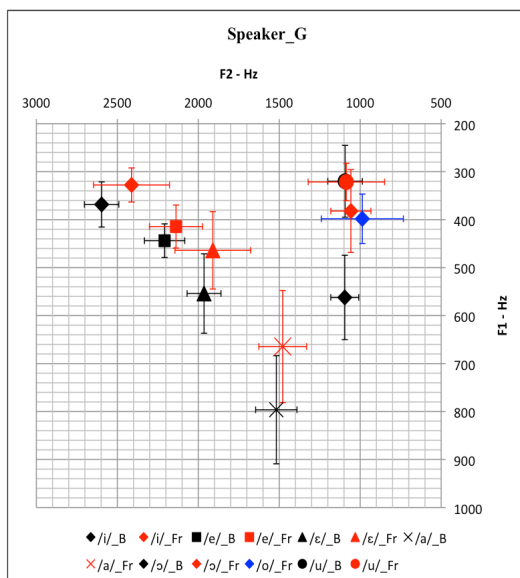


Figure 4D.7. Speaker_G: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

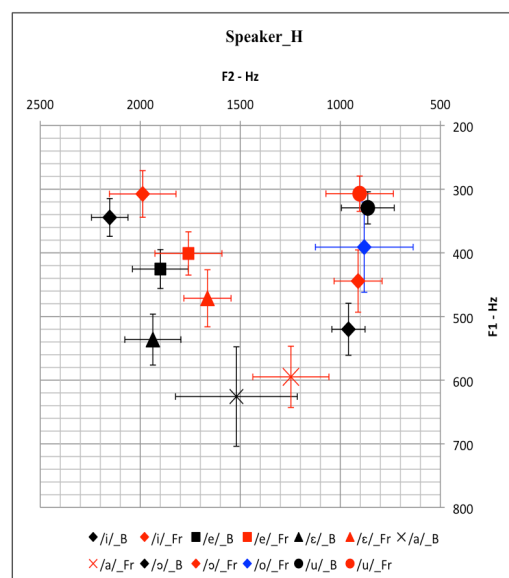


Figure 4D.8. Speaker_H: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

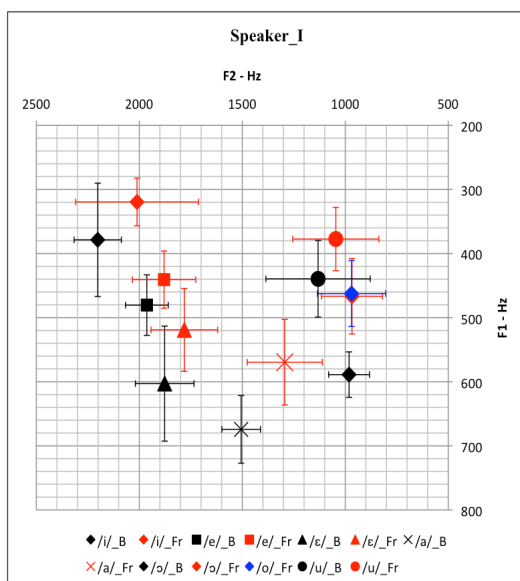


Figure 4D.9. Speaker_I: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

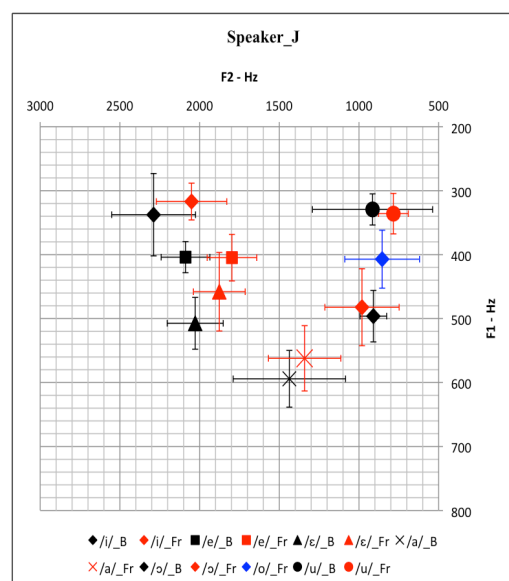


Figure 4D.10. Speaker_J: Mean F1 and F2 values and standard deviations for mid- and reference vowels in Béarnais and French.

APPENDIX 4E – NASAL UNITS TRANSFER

Dependent variable = F1 N = 285 Grand mean = -0.596		Deviance: 563 Degrees of freedom: 6		
Factor Group	Factor	Coeff.	N	P-value
Sex	Male	-0.151	140	0.00018
	Female	0.151	145	
Non-significant factor groups were Language (p=0.105).				

Table 4E.1. All speakers: Regression analysis for F1 values from Béarnais (/ɥ̃N/) and French (/œ/) (sequential nasal units).

Dependent variable = F2 N = 285 Grand mean = 0.166	Deviance: 441 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.634) and Speaker sex (p=0.126).	

Table 4E.2. All speakers: Regression analysis for F2 values from Béarnais (/ɥ̃N/) and French (/œ/) (sequential nasal units).

Dependent variable = F2 N = 100 Grand mean = 0.178	Deviance: 135 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.567) and Speaker sex (p=0.729).	

Table 4E.3. All speakers: Regression analysis for F2 values from Béarnais (/ɥ̃N/) and French (/œ/) (non-sequential nasal units).

Dependent variable = F1 N = 391 Grand mean = -0.404	Deviance: 792 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.693) and Speaker sex (p=0.697).	

Table 4E.4. All speakers: Regression analysis for F1 values from Béarnais (/ũN/) and French (/ɔ/) (sequential nasal units).

Dependent variable = F1 N = 147 Grand mean = -0.456	Deviance: 301 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.16) and Speaker sex (p=0.808).	

Table 4E.5. All speakers: Regression analysis for F1 values from Béarnais (/ũN/) and French (/ɔ/) (non-sequential nasal units).

Dependent variable = F1 N = 107 Grand mean = -0.266	Deviance: 252 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.871) and Speaker sex (p=0.54).	

Table 4E.6. All speakers: Regression analysis for F1 values from Béarnais (/ẽN/) and French (/ẽ/) (non-sequential nasal units).

Dependent variable = F2 N = 107 Grand mean = 1.009	Deviance: 261 Degrees of freedom: 6
Non-significant factor groups were Language (p=0.279) and Speaker sex (p=0.0936).	

Table 4E.7. All speakers: Regression analysis for F2 values from Béarnais (/ẽN/) and French (/ẽ/) (non-sequential nasal units).

APPENDIX 5A— MEANS AND STANDARD DEVIATION DATA (CHAPTER 5)

			/e/		/ɛ/	
			μ	σ	μ	σ
F1	Speaker_P	◆	358	(44)	403	(52)
	Speaker_Q	■	374	(40)	446	(74)
	Speaker_R	▲	380	(42)	459	(60)
	Speaker_S	▪	386	(77)	478	(111)
	Speaker_T	●	412	(43)	470	(68)
F2	Speaker_P	◆	1866	(195)	1706	(122)
	Speaker_Q	■	1924	(150)	1732	(174)
	Speaker_R	▲	1857	(164)	1788	(152)
	Speaker_S	▪	1946	(216)	1851	(201)
	Speaker_T	●	1867	(145)	1651	(155)

Table 5A.1. Middle Male speakers: Mean F1 and F2 values (Hz) for front mid-vowels (see Figure 5.2).

			/o/		/ɔ/	
			μ	σ	μ	σ
F1	Speaker_P	◆	377	(49)	373	(52)
	Speaker_Q	■	388	(41)	398	(44)
	Speaker_R	▲	444	(51)	445	(52)
	Speaker_S	▪	382	(62)	414	(71)
	Speaker_T	●	418	(62)	445	(50)
F2	Speaker_P	◆	947	(148)	969	(107)
	Speaker_Q	■	912	(174)	986	(139)
	Speaker_R	▲	897	(158)	886	(107)
	Speaker_S	▪	872	(174)	853	(119)
	Speaker_T	●	1026	(180)	1053	(102)

Table 5A.2. Middle Male speakers: Mean F1 and F2 values for back mid-vowels (see Figure 5.2).

			/e/		/ɛ/	
			μ	σ	μ	σ
F1	Speaker_K	◆	476	(77)	659	(141)
	Speaker_L	■	409	(36)	498	(84)
	Speaker_M	▲	470	(70)	639	(163)
	Speaker_N	▪	400	(63)	564	(142)
	Speaker_O	●	426	(31)	585	(112)
F2	Speaker_K	◆	2228	(206)	2042	(200)
	Speaker_L	■	2106	(121)	2001	(154)
	Speaker_M	▲	2312	(248)	2082	(247)
	Speaker_N	▪	2200	(175)	1958	(201)
	Speaker_O	●	2119	(194)	1882	(148)

Table 5A.3. Middle Female speakers: Mean F1 and F2 values for front mid-vowels (see Figure 5.4).

			/o/		/ɔ/	
			μ	σ	μ	σ
F1	Speaker_K	◆	469	(53)	474	(84)
	Speaker_L	■	466	(81)	497	(70)
	Speaker_M	▲	502	(82)	523	(85)
	Speaker_N	▪	418	(55)	495	(86)
	Speaker_O	●	438	(60)	516	(102)
F2	Speaker_K	◆	1063	(214)	1126	(163)
	Speaker_L	■	1009	(249)	978	(260)
	Speaker_M	▲	1027	(172)	1114	(171)
	Speaker_N	▪	1104	(287)	1155	(202)
	Speaker_O	●	980	(233)	1106	(181)

Table 5A.4. Middle Female speakers: Mean F1 and F2 values for back mid-vowels (see Figure 5.4).

			/e/		/ɛ/	
			μ	σ	μ	σ
F1	Speaker_Z	◆	371	(54)	415	(75)
	Speaker_@	■	408	(56)	444	(55)
	Speaker_\$	▲	449	(68)	547	(95)
	Speaker_£	▪	428	(92)	484	(92)
	Speaker_€	●	452	(40)	517	(71)
F2	Speaker_Z	◆	1883	(171)	1778	(128)
	Speaker_@	■	1765	(100)	1729	(123)
	Speaker_\$	▲	2129	(140)	1908	(198)
	Speaker_£	▪	1829	(127)	1805	(111)
	Speaker_€	●	1855	(140)	1764	(171)

Table 5A.5. Young Male speakers: Mean F1 and F2 values for front mid-vowels (see Figure 5.6).

			/o/		/ɔ/	
			μ	σ	μ	σ
F1	Speaker_Z	◆	376	(57)	413	(56)
	Speaker_@	■	408	(45)	450	(57)
	Speaker_\$	▲	443	(51)	498	(90)
	Speaker_£	▪	380	(68)	478	(84)
	Speaker_€	●	444	(53)	489	(77)
F2	Speaker_Z	◆	906	(222)	1071	(186)
	Speaker_@	■	991	(162)	1019	(94)
	Speaker_\$	▲	968	(209)	940	(142)
	Speaker_£	▪	1021	(210)	1118	(149)
	Speaker_€	●	917	(202)	988	(124)

Table 5A.6. Young Male speakers: Mean F1 and F2 values for back mid-vowels (see Figure 5.6).

			/e/		/ɛ/	
			μ	σ	μ	σ
F1	Speaker_U	◆	500	(42)	635	(107)
	Speaker_V	■	548	(73)	655	(113)
	Speaker_W	▲	507	(73)	572	(99)
	Speaker_X	▪	486	(71)	567	(79)
	Speaker_Y	●	424	(31)	536	(140)
F2	Speaker_U	◆	2105	(288)	2024	(242)
	Speaker_V	■	2188	(230)	1965	(164)
	Speaker_W	▲	2189	(188)	2022	(217)
	Speaker_X	▪	2299	(236)	2166	(199)
	Speaker_Y	●	1825	(76)	1738	(122)

Table 5A.7. Young Female speakers: Mean F1 and F2 values for front mid-vowels. (see Figure 5.8).

			/o/		/ɔ/	
			μ	σ	μ	σ
F1	Speaker_U	◆	490	(56)	639	(127)
	Speaker_V	■	526	(87)	584	(121)
	Speaker_W	▲	515	(78)	570	(102)
	Speaker_X	▪	476	(74)	499	(81)
	Speaker_Y	●	475	(86)	525	(92)
F2	Speaker_U	◆	1061	(172)	1322	(194)
	Speaker_V	■	1046	(268)	1087	(221)
	Speaker_W	▲	1070	(239)	1144	(198)
	Speaker_X	▪	1040	(275)	1196	(223)
	Speaker_Y	●	1056	(211)	1081	(201)

Table 5A.8. Young Female speakers: Mean F1 and F2 values for back mid-vowels. (see Figure 5.8).

			[ɛ̃N]	[œ̃N]	[ãN]	[ɔ̃N]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker_P	◆	374 49	369 66	551 75	388 51
	Speaker_Q	■	486 76	471 66	566 101	426 78
	Speaker_R	▲	499 66	463 18	618 51	476 52
	Speaker_S	▪	502 81	455 91	559 106	410 80
	Speaker_T	●	481 63	460 69	521 74	454 85
F2	Speaker_P	◆	1742 177	1288 133	1109 94	927 120
	Speaker_Q	■	1574 150	1441 130	1096 166	898 113
	Speaker_R	▲	1769 140	1441 164	1137 95	921 131
	Speaker_S	▪	1726 279	1395 251	961 151	807 106
	Speaker_T	●	1548 220	1254 134	1092 99	920 138

Table 5A.9. Middle Male Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in sequential (ẽN) nasal units (see Figure 5.9).

			[ɛ̃]	[œ̃]	[ã]	[ɔ̃]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker_P	◆	379 62	372 59	496 74	349 40
	Speaker_Q	■	516 65	490 44	566 122	439 78
	Speaker_R	▲	454 31	482 108	617 26	461 28
	Speaker_S	▪	474 107	554 -	530 107	445 121
	Speaker_T	●	507 65	483 35	482 56	465 65
F2	Speaker_P	◆	1782 231	1265 85	1106 138	1019 165
	Speaker_Q	■	1487 78	1443 130	1116 275	911 91
	Speaker_R	▲	1619 201	1417 164	1055 72	986 140
	Speaker_S	▪	1684 169	1392 -	967 109	829 159
	Speaker_T	●	1523 135	1387 298	1038 56	965 97

Table 5A.10. Middle Male Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in non-sequential (ẽ) nasal units (see Figure 5.12).

			[ɛ̃N]	[œ̃N]	[ɑ̃N]	[ɔ̃N]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker_K	◆	588 84	531 65	721 118	574 108
	Speaker_L	■	508 62	528 53	667 50	559 61
	Speaker_M	▲	682 112	589 143	785 102	608 142
	Speaker_N	▪	575 84	542 105	646 106	444 98
	Speaker_O	●	570 90	512 50	706 98	546 97
F2	Speaker_K	◆	2085 254	1557 187	1282 210	1032 150
	Speaker_L	■	1939 140	1653 195	1334 164	1034 124
	Speaker_M	▲	1891 282	1641 262	1269 136	1102 167
	Speaker_N	▪	1884 140	1670 235	1136 304	937 127
	Speaker_O	●	1828 193	1549 221	1226 150	962 108

Table 5A.11. Middle Female Speakers : Mean F1 and F2 values and standard deviations for nasal vowels in sequential (̃N) nasal units (see Figure 5.14).

			[ɛ̃]	[œ̃]	[ɑ̃]	[ɔ̃]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker_K	◆	695 122	577 95	591 91	533 54
	Speaker_L	■	548 84	448 96	658 135	496 69
	Speaker_M	▲	758 106	656 135	771 117	598 112
	Speaker_N	▪	503 92	571 86	641 132	456 127
	Speaker_O	●	581 82	570 64	637 112	546 85
F2	Speaker_K	◆	1800 192	1317 96	1147 156	1032 147
	Speaker_L	■	1928 76	1635 128	1178 200	1043 125
	Speaker_M	▲	1672 133	1497 156	1230 132	1026 165
	Speaker_N	▪	1779 343	1664 223	1254 359	967 151
	Speaker_O	●	1799 221	1439 162	1132 143	1014 127

Table 5A.12. Middle Female Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in non-sequential (̂N) nasal units (see Figure 5.16).

			[ɛ̃N]	[œ̃N]	[ãN]	[ɔ̃N]
			μ σ	μ σ	μ σ	μ σ
F3	Speaker_P	◆	2629 189	2512 130	2502 242	2599 197
	Speaker_Q	■	2769 151	2787 277	2752 172	2667 234
	Speaker_R	▲	2524 135	2462 96	2578 229	2620 277
	Speaker_S	▪	2483 385	2342 261	2406 268	2318 168
	Speaker_T	●	2564 238	2329 280	2432 341	2295 213

Table 5A.13. Middle Male Speakers : Mean F3 values and standard deviations for nasal vowels in sequential nasal units (see Figure 5.18).

			[ɛ̃]	[œ̃]	[ã]	[ɔ̃]
			μ σ	μ σ	μ σ	μ σ
F3	Speaker_P	◆	2586 214	2499 205	2618 224	2575 115
	Speaker_Q	■	2899 64	2761 310	2749 160	2707 272
	Speaker_R	▲	2500 210	2545 100	2491 181	2607 80
	Speaker_S	▪	2405 388	2119 -	2264 298	2358 259
	Speaker_T	●	2608 360	2804 523	2449 244	2462 158

Table 5A.14. Middle Male Speakers: Mean F3 values and standard deviations for nasal vowels in non-sequential nasal units (see Figure 5.19).

			[ɛ̃N]	[œ̃N]	[ãN]	[ɔ̃N]
			μ σ	μ σ	μ σ	μ σ
F3	Speaker_K	◆	3016 139	2897 227	2928 257	3061 395
	Speaker_L	■	2654 206	2582 152	3187 215	2759 210
	Speaker_M	▲	3205 136	3094 207	3446 425	3136 480
	Speaker_N	▪	2769 302	2786 227	2853 551	2577 581
	Speaker_O	●	2944 336	2952 373	3028 483	2948 267

Table 5A.15. Middle Female Speakers: Mean F3 values and standard deviations for nasal vowels in sequential nasal units (see Figure 5.20).

			[ɛ̃]	[œ̃]	[ã]	[õ]
			μ σ	μ σ	μ σ	μ σ
F3	Speaker_K	◆	3127 123	2928 175	3108 467	3072 386
	Speaker_L	■	2736 222	2554 193	2813 206	2612 173
	Speaker_M	▲	3266 103	2990 535	3232 640	3318 619
	Speaker_N	▪	2446 701	2838 344	2853 541	2658 376
	Speaker_O	●	2934 362	3020 58	2928 267	2945 223

Table 5A.16. Middle Female Speakers: Mean F3 values and standard deviations for nasal vowels in non-sequential nasal units (see Figure 5.21).

			[ɛ̃N]	[œ̃N]	[ãN]	[õN]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker_Z	◆	460 47	445 64	522 61	460 65
	Speaker_@	■	455 38	446 84	540 47	454 40
	Speaker_\$	▲	564 55	563 64	649 59	533 52
	Speaker_£	▪	554 43	546 35	617 29	488 61
	Speaker_€	●	580 38	534 43	594 50	530 59
F2	Speaker_Z	◆	1752 156	1695 241	1175 252	895 153
	Speaker_@	■	1625 214	1387 153	1247 129	1080 101
	Speaker_\$	▲	1876 230	1519 169	1179 154	1033 118
	Speaker_£	▪	1638 176	1467 126	1028 56	979 103
	Speaker_€	●	1567 208	1539 133	1051 222	947 195

Table 5A.17. Young Male Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in sequential (̃N) nasal units (see Figure 5.23).

			[ɛ̃]	[œ̃]	[ã̃]	[ɔ̃]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker_Z	◆	431 131	461 66	557 61	433 75
	Speaker_@	■	439 19	487 62	512 39	404 52
	Speaker_\$	▲	564 68	527 125	636 71	507 68
	Speaker_£	▪	572 61	545 93	603 40	526 84
	Speaker_€	●	554 84	567 57	625 53	544 58
F2	Speaker_Z	◆	1627 292	1485 142	1137 394	827 133
	Speaker_@	■	1665 135	1385 90	1299 133	1142 61
	Speaker_\$	▲	1771 177	1618 250	1163 108	1026 178
	Speaker_£	▪	1525 160	1484 148	1066 207	964 152
	Speaker_€	●	1419 96	1471 146	1085 256	946 186

Table 5A.18. Young Male Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in non-sequential (ṽ) nasal units (see Figure 5.25).

			[ɛ̃N]	[œ̃N]	[ã̃N]	[ɔ̃N]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker_U	◆	603 89	669 77	621 58	505 51
	Speaker_V	■	686 54	626 112	829 88	660 84
	Speaker_W	▲	647 68	631 122	781 52	657 126
	Speaker_X	▪	637 67	631 59	707 66	558 104
	Speaker_Y	●	598 110	510 138	709 107	562 85
F2	Speaker_U	◆	1867 280	1536 161	1268 141	1092 131
	Speaker_V	■	1928 176	1615 207	1231 102	1032 134
	Speaker_W	▲	2047 104	1576 175	1244 111	1031 167
	Speaker_X	▪	1957 234	1879 290	1183 231	930 143
	Speaker_Y	●	1747 186	1436 171	1105 96	1017 186

Table 5A.19. Young Female Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in sequential (ṽN) nasal units (see Figure 5.27).

			[ɛ]	[œ]	[ɑ]	[ɔ]
			μ σ	μ σ	μ σ	μ σ
F1	Speaker_U	◆	618 103	602 163	637 68	531 88
	Speaker_V	■	769 75	618 139	805 122	654 111
	Speaker_W	▲	657 85	644 123	767 59	601 102
	Speaker_X	▪	699 57	651 77	736 72	623 73
	Speaker_Y	●	613 123	570 42	705 59	611 125
F2	Speaker_U	◆	1699 226	1601 188	1195 115	1157 177
	Speaker_V	■	1935 138	1590 259	1264 138	1013 108
	Speaker_W	▲	1886 213	1562 168	1234 130	1080 120
	Speaker_X	▪	1931 119	1779 227	1267 243	1145 204
	Speaker_Y	●	1752 128	1481 55	1064 65	998 69

Table 5A.20. Young Female Speakers: Mean F1 and F2 values and standard deviations for nasal vowels in non-sequential (ñ) nasal units (see Figure 5.29).

			[ɛN]	[œN]	[ɑN]	[ɔN]
			μ σ	μ σ	μ σ	μ σ
F3	Speaker_Z	◆	2307 280	2143 216	2221 157	2287 148
	Speaker_@	■	2287 319	2158 124	2274 131	2196 121
	Speaker_\$	▲	2775 128	2680 460	2856 333	2577 456
	Speaker_£	▪	2312 160	1915 153	2108 118	2383 131
	Speaker_€	●	2533 210	2418 195	2308 161	2459 170

Table 5A.21. Young Male Speakers: Mean F3 values and standard deviations for nasal vowels in sequential nasal units (see Figure 5.30).

			[ɛ]	[œ]	[ɑ]	[ɔ]
			μ σ	μ σ	μ σ	μ σ
F3	Speaker_Z	◆	2325 597	1997 161	2275 170	2337 242
	Speaker_@	■	2236 216	2184 74	2258 152	2196 77
	Speaker_\$	▲	2733 105	2665 27	2859 229	2793 166
	Speaker_£	▪	2289 168	2130 204	2279 333	2389 191
	Speaker_€	●	2455 214	2467 241	2332 171	2497 161

Table 5A.22. Young Male Speakers: Mean F3 values and standard deviations for nasal vowels in non-sequential nasal units (see Figure 5.31).

			[ɛ̃N]	[œ̃N]	[ãN]	[õN]
			μ σ	μ σ	μ σ	μ σ
F3	Speaker_U	◆	3139 294	2836 285	2832 323	2740 188
	Speaker_V	■	3080 246	2852 406	2804 595	2865 611
	Speaker_W	▲	2818 325	2708 178	2670 150	2713 112
	Speaker_X	▪	3057 183	3043 244	2883 411	2660 293
	Speaker_Y	●	2924 284	2701 261	3052 223	2869 303

Table 5A.23. Young Female Speakers: Mean F3 values and standard deviations for nasal vowels in sequential nasal units (see Figure 5.32).

			[ɛ̃]	[œ̃]	[ã]	[õ]
			μ σ	μ σ	μ σ	μ σ
F3	Speaker_U	◆	2818 499	2866 342	2674 318	2852 225
	Speaker_V	■	3156 96	2567 812	2747 580	3082 569
	Speaker_W	▲	2662 411	2473 209	2735 249	2813 247
	Speaker_X	▪	3123 71	3074 81	3066 407	3033 310
	Speaker_Y	●	2994 302	2664 196	3018 220	2980 123

Table 5A.24. Young Female Speakers: Mean F3 values and standard deviations for nasal vowels in non-sequential nasal units (see Figure 5.33).