

Word prosody in early child Catalan, Spanish and English

Lluïsa Astruc¹, Elinor Payne², Brechtje Post³, Pilar Prieto^{4,5}, Maria del Mar Vanrell⁵

¹Department of Languages, The Open University, Milton Keynes, UK

²Phonetics Laboratory, University of Oxford and St Hilda's College, Oxford, UK

³RCEAL, University of Cambridge and Jesus College, Cambridge, UK

⁴Departament de Traducció i Ciències del Llenguatge, Universitat Pompeu Fabra, Barcelona, Spain

⁵ICREA, Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

l.astruc@open.ac.uk, elinor.payne@phon.ox.ac.uk, bmbp2@cam.ac.uk, pilar.prieto@upf.edu,
mariadelmar.vanrell@upf.edu

Abstract

The goal of this study is to examine the acquisition of prosody at the word level in early child Catalan, Spanish and English. We used a controlled naming task to elicit speech from 36 children; 12 English, 12 Catalan, and 12 Spanish, aged 2, 4 and 6 in order to analyze the acquisition of prosodic words with increasingly complex forms (S, WS, SW, WSW, SWW, WWS, SWSW; 3 target words per prosodic pattern in each language). We analyzed the prosodic patterns produced and quantified the omissions ("truncations") of weakly stressed syllables. Results are in line with previous studies [1],[2] in that there are developmental and crosslinguistic differences in the acquisition of complex prosodic word structures.

Index Terms: prosodic word, first language acquisition, metrical patterns, rhythm, Catalan, Spanish, English.

1. Introduction

It is believed that normally developing children typically have greater control of suprasegmental features such as loudness, pitch, and duration than of segmental articulatory movements and that they master these core prosodic features before they produce their first two-word combinations [3]. For this reason it is widely assumed that prosody is crucial for the acquisition of language (cf. the "prosodic bootstrapping hypothesis", e.g. [4]).

On the other hand, children need time to master complex prosodic word patterns as they typically omit syllables from multisyllabic words ("truncation") or add them so that early words tend to follow a strong-weak pattern (SW), e.g. [5], [6]. For instance, "baNAna" would be truncated to /'nana/, and so forth. This process is so pervasive in early child phonology that the existence of a possibly universal SW template, a "trochaic bias", has been proposed e.g. [7]. However, there is recent evidence that the early acquisition of prosodic word structure may be determined by the frequency of syllable and prosodic word structures in the ambient language rather than by universal constraints – in other words, any early phonological templates will follow from statistical frequencies in the input [5]; for a review see [8]. Children learning Spanish, a language with relatively simple syllabic structures and a higher statistical frequency of words with three or more syllables, can produce multisyllabic words much earlier than children learning German, as they do not have to contend with complex syllabic structures and they can concentrate in increasing the number of syllables (see [1], and [10] for

English; see [9] for French and English. Similar observations are made for Portuguese [11]). Results in [2], a longitudinal study of 2 Spanish and 4 Catalan children (1;1 to 4;00), suggest that the high frequency of SW forms in Catalan may account for Catalan children's early truncation of the pretonic syllable in WS and WSW prosodic words. On the other hand, Catalan has more monosyllabic and WS words than Spanish, due to the historical loss of masculine inflectional morphemes (Sp *Gato boNito*, Cat. *gat boNIC*). Indeed, as shown in [2], Catalan Child Directed Speech contains more monosyllables (Cat. 35%, Sp. 26%) and more WS words than Spanish (Cat 18%, Sp. 11%), but fewer SW words (Cat 31%, Sp. 41%), and WSW words (Cat. 9%, Sp. 17%). English Child Directed Speech, on the other hand, contains a higher proportion of monosyllabic words (80%) than Catalan and Spanish, and a much lower proportion of weak initial syllables (Eng. 3.8%, Sp. 44.6%) [14].

Our goal is thus to examine the acquisition of prosodic word structure in early child speech in Catalan, Spanish and English. We expect to find crosslinguistic differences in the age of acquisition of prosodic word patterns since English, Spanish and Catalan, and Spanish clearly belong to rhythmically different typological groups. English is the prototypical stress-timed language, with vowel reduction, and complex onsets and codas; Spanish is the prototypical syllable-timed language, with no vowel reduction and mostly CV syllabic structure; and Catalan, which has phonological vowel reduction and some complex codas is generally considered a mixed language (e.g. [12]. Using the same adult participants as the present study and a very controlled methodology, [13] found that Spanish and Catalan are more similar to each other, both tending towards a more syllable-based rhythm. Therefore, we predict that Spanish children will master complex prosodic words earlier than English children and that the prosodic word development of Catalan children will be more similar to that of the Spanish children than to that of English children.

2. Method

a. Subjects and procedure

We recorded 36 children interacting with their mothers. All recordings were conducted at the children's homes in sessions of about 40 minutes. The ages of the children were chosen so they fell into clearly differentiated developmental stages. The children (12 English, 9 girls and 3 boys; 12 Catalan, 7 girls

and 5 boys; 12 Spanish, 7 girls and 5 boys) were about 2, 4 and 6 six years of age at the time of the recordings.

The data were elicited with a naming game, based on short, animated clips, shown on Powerpoint slides on a laptop screen. The animations showed scenes, some with animals and some with everyday objects, that included the target word. Mothers were given written instructions explaining that they have to read a short story about a little fairy called Melanie who was looking for some objects and animals. According to the instructions, the mother asked her child to name the target words by asking “What is Melanie looking for?” or “What is this?” and then praised the child for getting it right, and repeated what the child had said. If the child said a different word, as for instance “ball” instead of the target word “balloon”, the mother had to encourage her to try again until the child used the target word. The dialogue was modeled for her in each slide, with the target word highlighted in a different colour. A typical dialogue went thus:

(1)
[mother] What is Melanie looking for?
[child] The balloon
[mother] Good! She is looking for the balloon.
[mother] Can you find it? There! Well done

b. Materials

The purpose of the material was to test the production of increasingly complex prosodic forms (S, WS, SW, WSW, SWW, WWS, SWSW, and SWSWW). The age of the children posed some methodological problems, since we had to rely exclusively on words that were both maximally familiar to young children and also imageable. We designed the corpus using the UWA MRC Psycholinguistic Database [15] for English, which we completed with data from Catalan and Spanish children’s books. Table 1 shows the words used.

	Catalan	Spanish	English
S	Sol Tren Peu	Sol Tren Pie	Sun Train Bee
SW	Nena Lluna Mono	Nena Luna Mono	Angel Baby Monkey
WS	Bebè Camió Lleó	Bebé Camión León	Guitar Balloon Giraffe
WSW	Sabata Pilota Pijama	Zapato Pelota Pijama	Potato Banana Pajamas
SWW	Àliga Música Mèlanie	Águila Música Mélanie	Elephant Crocodile Melanie
WWS	Cocodril Elefant Pantaló	Caracol Pantalón Violín	Cockatoo Kangaroo Violin
SWSW	Papallona Helicòpter Hipopòtam	Mariposa Elefante Cocodrilo	Caterpillar Watermelon Helicopter
SWSWW	(not available in child lang)	Hipopótamo Helicóptero	Hippopotamus

Table 1. Target words for the three languages.

We thus aimed at testing 8 prosodic structures, from monosyllables to the most complex structure that children can possibly be familiar with, namely SWSWW as in “hippopotamus”.

c. Analysis and acoustic measures

The sound files were analysed acoustically and instrumentally using *Praat* [16]. The first author and a research assistant analysed the target words acoustically. The research assistant transcribed them phonetically and annotated any deviations from the canonical segmental form. The first author validated the annotations and processed the data.

3. Results

a. Realisation of the target words

We obtained a corpus of 2835 words of which 1197 were in English, 724 in Spanish and 914 in Catalan, and which included five groups: children at 2, 4, and 6 years of age and adults talking to children (Child Directed Speech) and to the researcher (Adult Directed Speech).

For the study of truncation, we selected for analysis the first token produced by each child, preferably not repeated after the mother. We thus compare three age groups per language. The dataset for the study of truncation has a total of 790 words of which 47 were truncated.

First of all, we present a general picture of the word prosody acquisition using the whole database of 2835 (which includes repetitions). As we can see from the percentage of multisyllabic words in Figure 1, overall, the younger children produced less complex metrical structures than the older children:

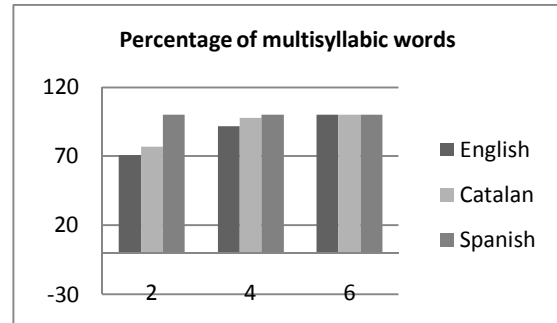


Figure 1. Percentage of multisyllabic words produced by children at ages 2, 4 and 6.

As shown by the histograms in Figure 1, there is an increase in the number of multisyllabic words (WSW, SWW, WWS, SWSW, SWSWW patterns) as children grow older, which is especially evident in English and in Catalan. The Spanish children, on the other hand, show no major changes in the percentage of multisyllabic words produced; they seem to be at an advantage from age 2.

Figure 2 shows the occurrences of each of the 8 target patterns. (There is no Catalan data for SWSWW).

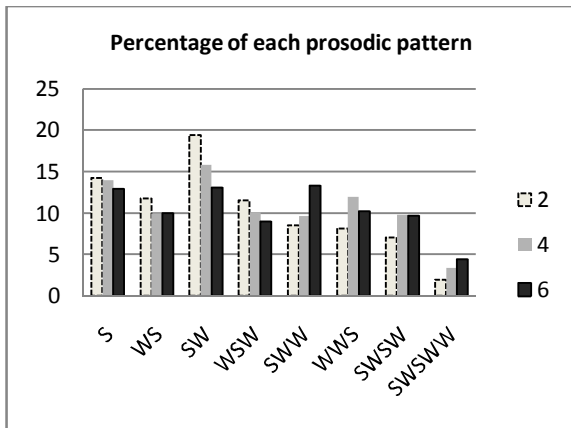


Figure 2. Percentage of each prosodic word patterns (horizontal axis) produced by all children.

The SW pattern (trochee) is the most frequent across all languages and age groups. As expected, the youngest children, produced a higher proportion of SW words (almost 30%) than older children (about 22%), whereas they produced a slightly lower proportion of the other prosodic patterns, except for WSW (younger children, 13%; older children, 11%). Prosodic development seems to imply expanding from a basic SW pattern to a WSW pattern and from this to increasingly complex forms.

As shown in Figure 3, a language by language analysis reveals crosslinguistic differences in the evolution of the multisyllabic forms. At age 2, English children realize mostly SW forms (18%), followed by S (12%), and by WS (12%), but they hardly produce any WWS. They thus show a very strong trochaic bias but also a very strong tendency to use disyllabic words. On the other hand, Catalan and especially Spanish children of the same age, produce higher proportions of the complex prosodic word forms (Sp. WWS, WSW, and SWSW; Cat. WSW, SWW, and WWS).

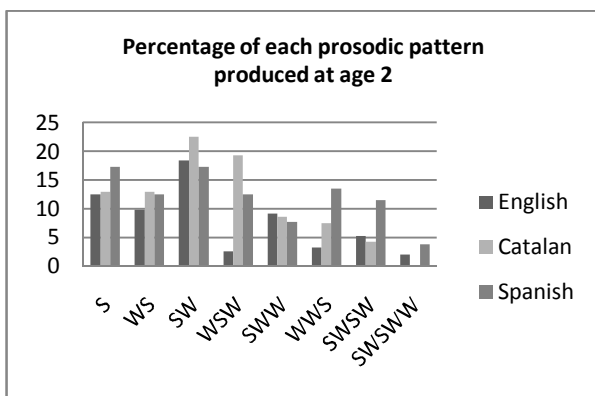


Figure 3. Percentage of prosodic patterns produced by 2-year-olds

As for the WSW patterns, Spanish and Catalan 2-year-olds produce a much higher proportion of WSW forms than English children do (Spanish 13%, Catalan 19%, against English 4%).

b. Truncations and other metrical deviations

For this study, we analyse one token per metrical pattern from each child; a dataset of 790 words. We classified as truncations those words where a whole syllable was omitted. All the instances of truncation in the database occurred in the speech of 2 and 4-year-olds. We observed two main types of deviations from the canonical pattern of the target words. The first type consisted in the omission of unstressed syllables (truncation). The second type consisted in alterations to the metrical but not the segmental structure of the word. We will only report on the first type here, because of space constraints. These are some examples of correct and truncated realisations in multisyllabic words (WWS and SWSWW):

(1) English (2 years, LER, SK, IG)

“Kangaroo”: [kɛmgə'u:] (correct), [ka'vu] (truncated);

[waj'u:] (truncated);

“Hippopotamus”: [həpə'pɛðɛmɪs] (correct); [həpə'pɛɪɛm:əs] (correct), [apθs'əθ:] (truncated; imitation).

(2) Spanish (2 years, BR, MF2, SS)

“Pantalón” (‘trousers’): [pata'lan] (correct), [puta'lon]

(correct), [padta'lon] (correct);

“Hipopotamo” (‘hippopotamus’) > ['ta:ta] (truncated; imitation), [porðamo] (truncated), [ipu'potamo] (correct).

(3) Catalan (2 years, AMB,OAP, BCJ)

“Pantalons” (‘trousers’): [pɛn'kilods] (correct), [panta'lons] (correct), [pa'lons] (truncated);

“Hipopotam” (‘hippopotamus’): ['pota] (truncated), ['pɛtam], [pu'pontam] (truncated).

Figure 4 shows the percentage of truncations per language and age group.

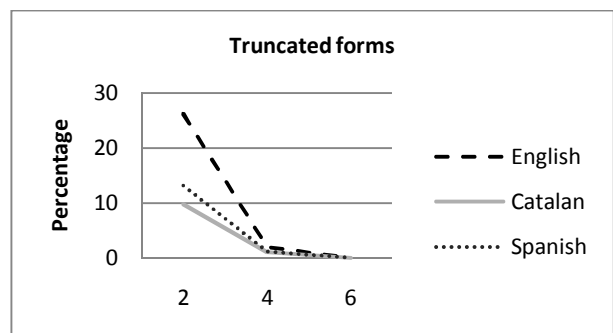


Figure 4. Percentage of truncated forms in English, Catalan and Spanish.

First of all, we observe a clear developmental difference across all language groups from age 2 to age 4 and to age 6. At age 4, children produce a mere 1% of truncations. At age 6, none of the children produced truncated forms anymore.

Although it is difficult to make generalisations, given the relative scarcity of the data points, we observe a clear crosslinguistic difference in this direction: Spanish and Catalan children produce fewer truncations than the English children. At Age 2, English children omit one or more

syllables in 26% of the forms they produce whereas Catalan omit syllables in just 10% of the cases and Spanish children in 13% of the cases. Furthermore, all 4 English children truncate words while both for Spanish and Catalan, one child in four produce all words correctly already at age 2. Truncation is thus more widespread in English than it is in Spanish and Catalan. We also observe clear crosslinguistic differences in the distribution of the metrical patterns truncated.

	Words	Target	Truncation
Catalan	hipopòtam	sww	sw
	Mélanie, música	sww	sw
	elefant, pantalons	ws	ws
Spanish	hipopótamo	sww	sw...sw, wws
	Mélanie, música	sww	sw
	mariposa, elefante	sww	sw, wws
	violín, caracol,...	ws	ws
English	hippopotamus,...	sww	sw...sw, wws
	caterpillar,...	sww	sw, sw...sw
	kangaroo, cockatoo,...	ws	ws
	elefant, butterfly,...	sww	sw, sw...sw
	balloon, guitar,...	ws	s
	banana, pyjamas,...	ws	ws

Table 2. Truncations per language at age 2

Table 2 shows the metrical patterns most frequently truncated at age 2 in all three languages. We see that only English children still truncate WS and WSW forms. Both in Catalan and in Spanish, the metrical patterns most frequently truncated are SWSW, SWW and WWS, which are mostly reduced to a SW form. Spanish and English children, additionally, truncate the SWSWW pattern (not available in the Catalan data) in several ways, from SW...SW to WWSW.

4. Conclusion

This paper offers an exploratory study of the acquisition of prosodic word structure in early child speech in Catalan, Spanish and English, at ages 2, 4, and 6. Our prediction was that Spanish children will master complex prosodic words earlier than English children and that the prosodic word development of Catalan children will be more similar to that of the Spanish children than to that of English children. This prediction has been borne out by the data. From age 2, Spanish children produce a much higher number of multisyllabic words, and overall, they produce a much higher proportion of complex prosodic word forms. Catalan children are closer to Spanish children than they are to English, and this is also evident in the patterns of truncation. By age 2, English children produce a 26% of truncated forms, while Spanish and Catalan children produce about half as many. We can thus conclude that the acquisition of metrical patterns is accomplished earlier in runs in Catalan and in Spanish than it is in English.

5. Acknowledgements

We would like to thank N. Argemí, A. Barberà, M. Jean Bell, A. Estrella, and F. Torres-Tamarit for recording the data, and to N. Hilton for performing the segmentation, phonetic transcription and coding of the data. This research has been funded by two Batista i Roca grants (Refs: 2007 PBR 29 and 2009 PBR 00018 respectively) awarded by the Generalitat de

Catalunya, and by the grant SG-51777 awarded by the British Academy. We also wish to acknowledge support from grants FFI2009-07648/FILO and 2009 SGR 701.

6. References

- [1] Lleó, C. & Demuth, K. (1999). Prosodic constraints on the emergence of grammatical morphemes: Crosslinguistic evidence from Germanic and Romance languages. *Proceedings 23rd BUCLD*, 407-418.
- [2] Prieto, P. (2006). The relevance of metrical information in early prosodic word acquisition: A comparison of Catalan and Spanish. *Language and Speech*, 49, 231-259.
- [3] Hallé, P. & Vihman, M. (1991). 'Beginnings of prosodic organization: rules and intonation and duration patterns of disyllables produced by Japanese and French infants'. *Language and Speech* 34.4:299-318
- [4] J. Morgan and K. Demuth (1996). Signal to syntax: An overview. *From signal to syntax: Bootstrapping from speech to grammar in early acquisition*. Hillsdale, NJ: Lawrence Erlbaum Associates, pp.171-84.
- [5] Gerken, L.A. (1994). A metrical template account of children's weak syllable omissions. *Journal of Child Language*, 21(3), 565-584.
- [6] Demuth, K. (1996). 'The prosodic structure of early words' In J. Morgan and K. Demuth *From signal to syntax: Bootstrapping from speech to grammar in early acquisition*. Hillsdale, NJ: Lawrence Erlbaum Associates, pp.171-84.
- [7] Allen, G.D. & S. Hawkins (1980). 'Phonological rhythm: definition and development'. *Child Phonology. Volume I: Production*. Academic Press.
- [8] Demuth, K. (2009). The prosody of syllables, words and morphemes. In E.L. Bavin (ed) *The Cambridge handbook of child language*. Cambridge; Cambridge University Press.
- [9] Vihman, M.M., DePaolis, R., & Davis, B.L. (1998). Is there a "Trochaic Bias" in early word learning? Evidence from infant production in English and French. *Child Development* 69, 933-947.]
- [10] Lleó, C. (2006). The acquisition of prosodic word structures in Spanish by monolingual and Spanish-German bilingual children. *Language and Speech*, 49, 207-231.
- [11] Vigário, M., Freitas, M.J., & Frota, S. (2006). Grammar and frequency effects in the acquisition of prosodic words in European Portuguese. *Language and Speech*, 49, 175-2003.
- [12] Ramus, F., Nespor, M., & Mehler, J. (1999). Correlates of linguistic rhythm in the speech signal. *Cognition*, 73, 265-292.
- [13] Prieto, P., Vanrell, M., Astruc, L., Payne, E. & Post, B. (This conference). Speech rhythm as durational marking of prosodic heads and hedges.
- [14] Roark, B. & Demuth, K. (2000). Prosodic constraints and the learner's environment: A corpus study. *Proceedings 24th BUCLD*, 597 – 608.
- [15] Wilson, M.D. (1988). The MRC Psycholinguistic Database: Machine Readable Dictionary, Version 2. *Behavioural Research Methods, Instruments and Computers*, 20(1), 6-11.
- [16] Boersma, P., & Weenink, D. (2007). *Praat: doing phonetics by computer* (Version 5.1.12). Retrieved August 4, 2009, from <http://www.praat.org/>.