Running Head: SPELLING AND READING WORDS IN BENGALI

SPELLING AND READING WORDS IN BENGALI: THE ROLE OF DISTRIBUTED PHONOLOGY

Shruti Sircar

The English and Foreign Languages University, Hyderabad

shrutisircar@efluniversity.ac.in

Sonali Nag

The Promise Foundation, Bangalore and

University of Oxford, UK

sonalinag@t-p-f.org

sonali.nag@education.ox.ac.uk

Spelling and reading words in Bengali: the role of distributed phonology

Shruti Sircar & Sonali Nag

ABSTRACT: Bengali orthography is only moderately transparent, and there are several striking instances of phonology-orthography and orthography-phonology inconsistency. In this chapter, we show that an index of advancing skills in Bengali word reading and spelling is knowledge of word level phonology. In particular, we show that in the early grades, an important task is to learn to read and spell words where phonological information is distributed across the word, neutralized or elided. While phonological neutralizations impact spelling more than reading, some forms of phonology-akshara mapping and non-linear arrangements in complex akshara impact both reading and spelling.

KEYWORDS: Bengali, spelling, reading, consonant clusters, distributed word level phonology, inherent vowel, phonology-akshara mapping, phonological neutralizations, orthographic representation

1. Introduction

An important contributive factor in spelling and reading acquisition is the relative consistency of mapping between phonology and orthography. In transparent orthographies such as Finnish and Turkish, children can spell and read most words once they know the basic symbol set and the sounds they map to. In contrast, the transition into spelling and reading does not run as much in parallel in the opaque orthographies, with cross-linguistic evidence building up from the 1990s to show that spelling development lags behind reading development (e.g. French: Geva, Wade-Woolley, & Shany, 1993; Portuguese: Pinheiro, 1995; Persian: Sprenger-Charolles, Siegel, & Bonnett, 1998; Kswahili: Alcock & Ngorosho, 2003; and Hebrew: Rahbari, Senechal, & Arab-Moghaddam, 2007; Ravid, 2011). This dissociation in development is because spelling, unlike reading, adds a new challenge with a phonological recoding process where speech sounds need to be mapped to symbols and each symbol has to be recalled anew. In the akshara orthographies not enough is known about whether spelling and reading development are in step or uneven. Single study reports suggest that spelling knowledge is slower to develop compared to reading, and the gap may be determined by the extent of transparency in an individual akshara-based language (e.g. Hindi: Vaid & Gupta, 2002; Kannada: Nag, 2014; Thai: Winskel & Iemwanthong, 2010). The

pressure points appear to emerge because of the extensive symbol repertoires of these orthographies and the language-specific instances of inconsistency in phonology-akshara mapping. There is one further potential pressure point linked to the phonological information distributed across the word that may influence the phonological realization of a word. Although there are suggestions in the literature that such word level details matter for decoding (e.g. role of syllable weight: Pandey, 2014) their role on literacy acquisition is yet to be studied.

We turn to Bengali to study the relative patterns in spelling and reading focusing on inconsistencies and word level phonology. In Bengali, the mapping of orthography and phonology may be inconsistent and this inconsistency may occur either uni- or bi-directionally. Word level phonology may also contribute to rules of orthographic representation that are not immediately clear. In this chapter we begin with a description of Bengali phonology describing both the consistencies as well as the inconsistencies with the orthography. We also describe the underpinnings of word level phonology. Throughout, we use the Indo-Aryan sister language of Hindi to contrast the description of phonology, orthography, and the mapping principle, with a limited attention to some of the other Indic languages. These sections are followed by our analysis of spelling and reading development in a group of Bengali children in Grades 2, 3 and 4, which highlight that in both spelling and reading one needs to go beyond akshara-phonology mapping to actively engage with word-specific phonological rules. We will show that an index of advancing skills in word reading and spelling draws upon knowledge of word level phonology.

2. Bengali: among the five largest speaker communities in the world

With nearly 230 million speakers, Bengali is one of the most spoken languages ranking fifth in the world. Bengali is the national and official language of Bangladesh, and in India, is the official language of the state of West Bengal and the co-official language of the states of Assam and Tripura, an official language of Sierra Leone and is spoken in Andaman and Nicobar Islands, especially the Neil and the Havelock Islands. Bengali is spoken by a significant immigrant population in the United Kingdom, Canada, USA, Malaysia, and Singapore. The Bengali orthography is also used to write several languages of India including Oxomiya (Assamese), Daphla, Garo, Hallam, Khasi, Manipuri, Mizo, Munda, Naga, Rian, and Santali.

Bengali has an elegant orthographic system: It is, on the one hand, organized around the alphasyllabic principle, and, therefore, sufficiently regular and predictable, and, on the other hand, wrought with complex orthographic conventions. This combination of regularity and complexity is what makes the Bengali orthography interesting for comparative research on literacy acquisition. In Bengali, the phonology-to-akshara and akshara-to-phonology mapping is not always balanced. There is typically a consistent one-to-one akshara-phonology mapping, but in a small number of akshara, there is one-to-two mapping, with one symbol linked with two phonological units. In addition, there are instances of mapping where one phonological unit is represented by either more than one akshara or by just one part of the akshara symbol block. Perhaps the starkest example of inconsistency in the orthography is with consonant clusters because several have unexpected pronunciations, including instances of one consonant in the cluster becoming a geminate in some contexts and the second consonant unvoiced in other contexts (further details in the next section). Making the phonology-to-orthography linkage in Bengali, therefore, depends on not just fine-grained knowledge about specific mapping features in the orthography, but more. We have argued elsewhere for the roles of lexical, morphological, and etymological factors in furthering orthographic knowledge (Sircar & Nag, 2014). In this chapter, we argue that akshara as well as word level phonology inform the linkages of orthography-to-phonology and phonology-to-orthography, and because these linkages are less evident, they are potential pressure points for a beginning learner, and mastery of these details is central to progress in literacy skills.

3. Bengali phonology and orthography

The Bengali symbol set evolved from the *Kutila lipi*, a descendant of Brahmi, which with some modification is also used for the Oxomiya, Manipuri, and Maithili languages. The Bengali orthography with 46 basic akshara (those with inherent vowels) is an alphasyllabary or abugida, and as in Sanskrit every independent consonant carries the inherent vowel /ɔ/ or /o/ [compared to /ə/ in Hindi], and in this, the architectural principle is similar to the Devanagari and all other Brahmi derived scripts. The systematic features of the orthography are as follows: It goes from left to right but quite unlike Roman, Arabic, Hebrew, and Cyrillic, symbols hang from a top line, using upstrokes as well as down strokes. The akshara are symbol blocks where diacritics are written in all four directions to indicate non-initial vowels and some consonants.

Phonologically, Bengali allows closed syllables, and has 16 canonical syllable patterns (Sarkar, 1986), with CV syllables constituting 54% of the whole language (Dan, 1992). Consonant clusters occur in only onset positions, with the exception of loan words, where coda clusters are permitted. Bengali allows a large set of consonant clusters in word medial positions, and a cluster may contain up to three consonants, e.g. স্ত্রী *stree* /stri:/ 'woman'[1] . The example of /stri:/ is also an excellent example of how one akshara captures multiple phonemes (in this instance three consonants and one vowel) and demonstrates how in Bengali some phoneme markers are clearly distinguishable segments in the symbol block but others are opaque and fused together (more details below).

3.1 Vowels and diphthongs

Bengali has seven vowels and all of them have a nasal counterpart, changing the meaning of the word; for instance, the pronunciation of the honorific pronoun for third person is the nasalized /tã̆r/, clearly distinguishing the pronoun from the third person general /tar/. This contrast between oral and nasal vowels in Standard Bengali in India (Masica 1991: 118) is not characteristic of Bangladeshi Standard Bengali, presumably due to an Eastern dialect influence within Bangladesh (Majumdar 1997: 108). The Indo-Aryan distinction of short and long vowels (e.g. /i:, i:/ and /ʊ, u:/) is merged in Bengali, and, therefore, the vowel length distinction does not hold anymore. However, the Bengali orthography continues to retain these distinctions, introducing systematic inconsistency between the spoken and written form. Bengali also has a unique low-high vowel distinction in /æ/ and /e/ which is captured in orthography in the grapheme এ.

Vowels have two forms, a full and a diacritical form (also called the primary and secondary forms). The full form appears in the word initial position, and after a CV akshara (with an inherent vowel as in বই *bai* /boi/ 'book' or any other vowel as in ভাই *bhai* /b^{h}ai/ 'brother'). The diacritical form of a vowel is placed vertically above, below, or to either side of the consonant, and visual elements used in some diacritics can combine to make other unique diacritics. Taking the number of visual elements in a diacritic as a symbol parameter, Bengali

[1] Bengali words are transcribed first as they are represented in orthography using ITRANS, followed by the phonetic transcription in IPA, and gloss. The inherent vowel of Bengali akshara pronounced as /ɔ/ or /o/ is denoted by [a].

vowels can be classified into: (1) vowels with a single element e.g. কা /ka/ িক /ki/, েক /ke/ কী /ki:/, কু /ku/, কূ /ku:/, (2) vowels with a two-part diacritic েকা /ko/, ৈক /koi/ and (3) vowels with a three-part diacritic, as in the case of the diphthong marker /kou/ কৌ.

There is no consensus on the number of diphthongs in Bengali: It is not clear whether the resultant word is monosyllabic, or disyllabic with a hiatus in between the vowels as in খাই *khai* /k^{h}ai/ 'eats' (habitual) as found in disyllabic words like টিয়া *Tia* /tia/ 'parrot.' Diphthongs are distinguished from the pure vowels (/i/, /u/, /e/, /o/, /æ/, /ɔ/) by the presence of a non-syllabic semivowel (Chatterjee, 1926). Old written Bengali shows evidence of a vowel-semivowel-vowel sequence as in সুইয়া *suiya* /ʃuija/ 'having slept,' লইয়া *loiya* /loija/ 'having brought,' and খাইয়া *khaiya* /k^{h}aija/ 'having eaten.' These were distinct because of the presence of a full form of the ই /i/ followed by a semivowel য় /j/. The count of diphthongs varies from 17 (Sarkar, 1985 as cited in Kar, 2010:17) to 31 (Hai, 1975). Most diphthongs are written as a combination of a diacritical form of the first vowel (or left unmarked if the inherent vowel) and a full form for the second vowel, except for the two distinct diphthongal akshara, ঔ /ou/ and ঐ /oi/.

In Bengali the inherent vowel with a consonant akshara may be realized as /ɔ/ or /o/, or may be suppressed: The latter phenomenon is akin to the Hindi schwa deletion (Ohala 1983; Pandey, 1990). The choice between /ɔ/ and /o/ is largely phonological, with /ɔ/ not occurring in the first syllable unless it is followed by a high vowel and /o/ occurring before and after a consonant cluster. Schwa deletion is subject to phonological and morphological conditions: The schwa cannot be deleted if it is in the first syllable, before and after a consonant, before a vowel (which results in a heavy syllable), and before a coda consonant. There is no specific orthographic (or other) rule to indicate to a reader how the inherent vowel of an akshara may be pronounced: For example, the realization of the inherent vowel in the akshara ত in তন *tana* 'body' is /tɔ/, in তটি *taTi* 'river' it is /to/ and in the word medial নাতনি *naatani* 'granddaughter' it is /t/ with a schwa deletion. Moreover, since the schwa deletion in Bengali is not indicated in orthography, it results in homographic words. For instance, শোল *shola* can be read as /ʃol/ 'a type of fish' or /ʃolo/ 'sixteen,' which only context can disambiguate.

However, even while High varieties of Bengali continue to not indicate schwa deletion in orthography, low varieties may suggest closeness to phonology by writing /sholo/ with the /o/ vowel diacritic available in the symbol repertoire, শোলো (Dasgupta, 2003).

Bengali shows vowel height assimilation (Chatterjee, 1926: 395-421; Dan, 1992: 57-63) where low vowel sounds gain height because of a neighboring vowel, e.g., প্যাঁচা *pyancha* /pæ̃tʃa/ 'male owl' becomes পেঁচি *penchi* /pẽ̞tʃi/ 'female owl' (æ> e), and নট *not* /nɔt/ 'male play actor' becomes নটী *noti* /noti/ 'female play actor' (ɔ > o). We can expect that access to these fine-grained word-level phonological rules would be essential to avoid reading words with the inherent vowel where a schwa drop is expected. In other words, orthography must be overridden by language-specific phonological processes, and we will examine these tensions in the reading and spelling of primary schoolers later in the chapter.

2.2 Consonants and consonant clusters

An obstruent-heavy language, Standard Bengali has 30 consonantal phonemes, of which 23 are plosives and affricates, each with a voiced and an unvoiced variant, and an unaspirated and aspirated variant. All consonants except /ŋ, ɽ, ɖh/ occur word initially as onsets.

Phonological neutralization or mergers have led to a discrepancy between Bengali phonology and its classical ancestry. Put differently, several sets of classical consonants have merged, resulting in loss of historical phonological distinctions. The voiceless sibilants শ, ষ and স have merged to the palatal /ʃ/, typically word initially and in intervocalic singletons. The /ʃ/ and /s/ distinction continues to be realized in medial clusters (e.g. /aste/ 'softly' vs. /aʃ1e/ 'to come') and word-finally (e.g. /bas/ 'enough' vs. /ba:ʃ/ 'bamboo'). Bangladeshi Standard Bengali, however, systematically maintains the contrast word-initially as well, e.g. /sirka/ 'vinegar' vs. /ʃira/ 'syrup' (Masica 1991: 98; Dasgupta 2003: 360). As in Hindi, Bengali has three rhotic akshara ড়, ঢ় and র (palatal, retroflex and dental respectively) – the first two have merged, though some speakers may maintain a marginal distinction between the two in formal registers, whereas Bangladeshi Standard Bengali and many Eastern dialects have only one rhotic /ɹ/ (Dasgupta 2003: 359; Masica 1991: 97). The retroflex and the dental nasals ণ and ন have neutralized to the dental, though Bengali orthography continues to mark these

historical distinctions. This is in contrast to Hindi where all these phonemic distinctions are retained, though in fast speech they may get neutralized, as in the case of neutralization between the retroflex and palatal sibilant (Shapiro, 2007).

Ambiguity in Bengali spelling also is because of allography in the phoneme /j/: Word initially, it is written with য (as in যুব *juba* /dʒubo/), and as য় after a vowel (e.g. পায়রা *paayaraa* /paera/ 'pigeon' and realized as /e/) or a consonant with an inherent vowel (e.g. নয় *naya* /noi/ 'nine'). The /j/ in consonant clusters, however, appears in a diacritical form (e.g. প্যাঁচা *pyaancha* /pæ̃tʃa/ 'owl').

Turning to consonant clusters, Bengali has 62 consonant clusters out of which eleven occur in the word-initial position (for e.g., /pr, gr/) and 41 word medially. Though medial consonant clusters are common and may occur in any combination, onset consonant clusters are restricted and are in a distinct combination of rising sonority: Plosive obstruent + liquid/nasals /kr, kl, gr, gl, tr, ɖr, ɖhr, nr, pr, pl, br, bhr/ and nasal + liquid /mr, ml/ (Kar, 2010; Heimisdóttir, 2013). However, a coronal obstruent /s/ also occurs as a word initial cluster /sk, skh, st, sth, sp, sn, str, spr, skr/ in words borrowed from Sanskrit. All sounds except /ŋ/, /h/ and /r/ can occur as geminates.

In Brahmi scripts, when two consonants meet without an intervening vowel, they coalesce and form a conjunct akshara (a CCV akshara). To demonstrate the pervasiveness of the coalesced akshara in Bengali, we continue our comparison with Hindi. The Hindi conjuncts are formed by writing them one after the other, one below the other, one above the other or by fusing them in a non transparent way (see Mathur & Nag chapter). The first CCV form is the most frequently used while the second and the third are somewhat less common, and the fourth is rare. In Bengali, again by contrast, all four configurations are used frequently with the opaque fourth form being used for many clusters (e.g. ষ + ণ =ষ্ণ, / sha + na = shna/; ক + ত = ক্ত, /ka+ ta = kta/). It is possible that the various ways of coalescence add to the cognitive demands of learning the CCV akshara set in Bengali. Interestingly, in an attempt to reduce the burden of such learning on young learners, effort has been made in the two main Bengali-speaking regions of South Asia (West Bengal in India and Bangladesh) to reduce the sheer

variety in akshara with informal orthographic reform of specific consonant clusters. Modern Bengali textbooks are beginning to contain more and more transparent orthographic forms of consonant clusters in which each constituent consonant of a cluster is readily apparent (e.g. Kishalaya, 2004). However, this change is limited to school textbooks and is not reflected in the rest of the Bengali printed literature. A child eventually will have to learn to recognize both the new transparent and the old opaque forms, leading to a further increase in the already extensive Bengali symbol repertoire.

Moreover, conjunct consonants in Bengali with the second consonant /v/, /j/, /m/ have phonological values different from the ones represented in orthography (see Table 1). The choice of these akshara in spelling appears arbitrary because they have no discernible phonological cues suggesting that their use must be learned by rote. Unlike Sanskrit and Hindi, which have no silent consonants, Bengali also leaves some second consonants of clusters unpronounced. This phenomenon is especially for words borrowed from Sanskrit, where the spellings reflecting the historic pronunciation are retained but are pronounced differently now. The second consonant in a cluster also impacts the syllable differently depending on the position of the cluster in the word. Word initially, they influence the following vowel by nasalizing, raising, or lengthening them. Word medially, they induce a gemination of the primary consonant, a phenomenon similar to Hindi though without the consonant drop seen in Bengali; for e.g., *vishwa* 'world' /viʃvə/ > /viʃʃvə/; *mithya* 'lie' /mitja/ > /mit^{h}t^{h}ja/ (Pandey, 2007).

INSERT TABLE 1

Another issue that confounds spelling in Bengali is how medial consonant clusters are represented: (a) with two full consonants, e.g. করতাল *karatala* /kɔrtal/ 'cymbal,' (b) with a conjunct, e.g., গন্ধ *gandha* /gɔndho/ 'scent,' or (c) with a diacritic *hasanta* marker / hɔsôntô/ which indicates suppression of the inherent vowel in the first consonant of the cluster, e.g., ঝিমঝিম *rimajhima* /dʒ^{h}imdʒ^{h}im/ 'tingling'. A final instance of inconsistency related to word level phonology is common, and this is when individual consonants in a cluster are not pronounced as would be implied by individual phonemic markers in the CCV

akshara. For example, despite the cluster being an orthographic representation of /ʃ/ and /l/ (শ and ল = শ্ল) it is pronounced as /sl/. Thus, in the Bengali orthography, consonant clusters may be represented by different and sometimes irregular forms. Added to this, learning to read and spell is complicated by the sheer size of the full akshara set of CV and CCV combinations, which number to more than 350 (Sircar & Nag, 2014). The original claim by Nag (2007) that children take several years to learn the whole set of akshara symbols has been replicated in several languages including Bengali (e.g. Hindi: Vaid & Gupta, 2002; Bhide et al. under review; Malayalam: Tiwari, Nair, & Krishnan, 2011; and Bengali: Sircar & Nag, 2014). However, apart from the item-based learning of the symbol set, the ease with which words can be read and spelled depends on the extent of transparency (Nag, 2017), and perhaps the distributed phonological information in the word.

4. Instruction in Bengali akshara

In Bengali, orthography instruction happens in phases: Teaching of the simple akshara (with inherent vowel) is followed by akshara with a ligatured vowel, and finally children are taught the geminates and mixed clusters (Nag & Sircar, 2008). These symbol sets are taught through copy writing and recitation of singleton akshara and akshara embedded in word context as reported in other Indic orthographies (Kannada: Nag, 2013; Malayalam: Tiwari et al., 2011;). However, unlike many other akshara orthographies, in Bengali learning, children are taught to spell out each component in an akshara, essentially making this literacy instruction a phoneme-based method. Attention is drawn to consonant components in conjunct akshara through practice in words with these akshara For example the cluster ন্দ /nd/ is taught using writing lists belonging to specific word families like ছন্দ *chanda* /tʃʰɔndo/‘verse,’ বিন্দু *bindu* /bindu/ ‘dot,’ বন্দ banda /bɔndo/ ‘close’, and নিন্দে *ninde* /ninde/ ‘criticism’ (for comparison see Hindi instruction in Mathur & Nag chapter and Tamil instruction in Nag & Narayanan chapter).

Unlike in other akshara teaching practice (Kannada: Nag 2014; Gujarati: Patel: 2004; Sinhala: Wijayathilake, Parrila, Inoue & Nag, in press), most of the consistent and frequent CCV akshara in Bengali are introduced by Grade 3. These are the transparent CCVs where

the two consonants are placed on a vertical line or one above the other. A limited range of opaque CCV akshara where the two phonemic markers cannot be separated is also introduced. The infrequent and rare CCV akshara (e.g. ক্ত /ktr/, ঋ্য /tmj/, ন্ট্র /ntr/ ম্ভ্র /mbhr/) are not taught explicitly but may incidentally feature in texts in the later grades (similar to the pattern of text encounters reported in Kannada, Patel, Bapi & Nag, 2013). Though the general rules of ligaturing in CCVs are taught, not all CCVs are introduced, and the onus of learning these are on the learners on the basis of reading exposure mirroring the teaching practice in the Dravidian language, Kannada (Nag, 2014). Formal training in akshara is discontinued by Grade 3.

Taken together, the previous sections show that the Bengali orthography is only moderately transparent, and there are several striking instances of phonology-orthography and orthography-phonology inconsistency. The teaching of the orthography brings attention to the phonemic markers in the symbol blocks which could help learners disambiguate some but not all the inconsistencies in mapping triggered by word level phonological processes. We turn next to a survey of children's reading and spelling to examine whether these instances of inconsistencies and word level phonological processes impact performance, and, especially, based on the literature, whether spelling is impacted more than reading. We will particularly consider whether specific insights dependent on processes other than phonological recoding can describe advances in Bengali reading and spelling development.

5. Language-specific features affect Bengali reading and spelling

We assessed Bengali children ranging in age from 7 to 10 years from Grades 2, 3, and 4. All participating children had Bengali as the main home and neighborhood language, and were learning to read and write Bengali at school. Ninety-four children were chosen from a pool of 2281 children from five schools across Kolkata (India) as average performers for their grade (scores between 0 and 1 standard deviation for a given grade). The scores were a composite of three tests: initial phoneme identification, word reading in context, and reading comprehension. The typically developing groups consisted of 37 children from Grade 2 (M_{age}=7;1, SD=0.42); 27 from Grade 3 (M_{age}=8;6, SD=0.49); and 30 from Grade 4 (M_{age}=9,4, SD=0.45). On the composite score, children in Grades 3 ($M_{accuracy}$= 72.7%; SD=4.18) and 4

($M_{accuracy}$= 77.5%; SD=2.60) were higher than Grade 2 ($M_{accuracy}$= 30.4%; SD=22.17) but similar to each other, U= 111.51, $p<0.01$. Given the substantial overlap in attainment levels in Grades 3-4 (a phenomenon often reported in Indian samples, e.g. Nag, Treiman & Snowling, 2010) we pooled the data and refer to them as the More Skilled (MS) Grade 3-4 group to contrast them with another group of children who we picked from the same grades (Grades 3-4) because their composite score was in the lowest 15%. This lower achieving group of 15 children (M_{age}=9;07, SD=0.71) was identified as the Lesser Skilled (LS) Grade 3-4 group. We were interested to see if the three groups (Grade 2, LS Grades 3-4, and MS Grades 3-4) would fall along a continuum of increasing attainments, or whether, for some aspects of skill development, the LS Grades 3-4 group would fall behind the younger Grade 2 group.

Children were assessed for reading accuracy on 15 words and 15 nonwords which had both CV and CCV akshara with the CCV either in a word initial or medial position. The words were sourced from Grade 2 and 3 textbooks, thus ensuring that all akshara in the assessment lists were from the taught set in school. The nonwords were derived by manipulating one akshara in a different word list also derived from akshara taught up to Grade 2. Orthographically, the word medial CCVs were either represented with two full consonants (i.e. with schwa suppression) or two half forms where the final CCV akshara was either transparent or opaque. Children were also assessed on 30 spellings on words with CV and CCV akshara (10 geminates or 10 mixed clusters). Of the words with the CCV akshara, some were irregular since the second consonant in the cluster was silent or obviated (a silent marker) by the geminating first consonant in the cluster (see Table 1). The words in the test also varied in word length with 10 each of monosyllabic, disyllabic, and trisyllabic words. Table 2 presents the accuracy scores on the three tasks for the three groups of children: those in Grade 2, and those who are lesser skilled and more skilled in Grades 3-4.

INSERT TABLE 2

There was no difference between the younger readers and the lesser skilled older group on the spelling scores, although the more skilled older children were far ahead. Word reading was at ceiling for all groups perhaps because of our choice to limit the word list to those that

contained words only taught up to Grade 2. The profile of scores may have been different if the list also contained words with low frequency, later encountered words. But scores show dispersal on the nonword reading task despite this list also comprising items with akshara taught by the end of Grade 2. Here, the LS Grade 3-4 group scored lower than the younger Grade 2 children even though they were better on word reading. This difference in pattern of scores is understandable because in reading words, children can identify individual phonemes and string them together and read them by mapping them onto a known lexical item. Such lexical cueing is unavailable in nonword reading. Nonword reading in Bengali, as in other languages, is therefore a better indicator of children's knowledge of akshara-phonology mapping. In addition, we found a moderate but significant correlation between nonword reading and performance on spelling (Grade 2: $r=0.414$, $p < 0.05$; MS G3-4 group: $r=0.386$, $p < 0.05$; however associations were not significant for the Low Skilled G3-4 group: $r=0.377$).

5.1 Word length and akshara type in reading and spelling

One would expect longer words (with more syllables) to be more difficult to read and spell than shorter words. Though polysyllabic words were relatively more difficult to spell across all groups ($M_{accuracy}$ was 30%, 32% and 58% in Grade 2, the LS Grade 3-4 and the MS Grade 3-4 groups, respectively), it was the phonetic density (the ratio of consonants to vowels) that explained the error patterns more than syllable length. For example, within the monosyllabic word set, the CVC nonwords were read more accurately than the words with CCVC (e.g., কেফ, *kefa* /kef / was easier than গ্রিল *grila* /gril/). Or, put differently, longer items but with only CV akshara were easier than shorter items but with CCV akshara (e.g. বিছিন *bichina* /bitʃin/ was easier than রগ্না *ragna* /rɔgna/). This pattern replicates trends in other akshara orthographies on length and complexity in reading (Sinhala: Wijayathilake & Parrila, 2014) and in spelling (Kannada: Nag, et al, 2010). We look at the specific points of difficulty in reading and spelling CCVs, with reference to transparency and visuo-spatial configuration, later in the chapter.

In spelling, CV akshara were easier to read (accuracy above 85% in all groups) than to spell (around 70% for Grade 2 and the LS Grade 3-4 group and 78% for the MS Grade 3-4 group). CV akshara were relatively less easy to spell because of the ambiguous nature of C_o and C/o/ and the use of the long and short vowel digraph. They were also easier to read than mixed

CCV akshara (76% and 79% in Grade 2 and the LS Grade 3-4 group respectively)[2]. The difficulty in the acquisition of CCV clusters was more pronounced in spelling words with CCV akshara: Grade 2 and LS Grades 3-4 group accuracy was less than 50%, and the MS Grade 3-4 group was at about 73%. In the CCV clusters, geminates were less prone to error (accuracy rates: Grade 2: 73%, LS Grades 3-4 group: 69%; MS Grade 3-4 group: 89%) than mixed clusters (accuracy rates: Grade 2: 32%, LS Grades 3-4 group: 32%; MS Grade 3-4 group: 62%). Within mixed clusters, C/r/ clusters were less prone to error than /n/C clusters.

5.2 The role of vowel length neutralization and vowel harmony

Recall that in modern Bengali, phonology has neutralized the distinction between long and short vowels (i.e. /i, i:/ and /u, u:/ merged into /i/ and /u/, respectively). The trends in the data suggest that in word reading the neutralization was easily applied by a beginning reader. The application of neutralization was evident in the nonword লেরা lera which could be read as /lera/ or /læra/ because of ambiguity of representation. More than 80% of the children read the word as /læra/ where the high-mid vowel /e/ was replaced by a low vowel /æ/ in the presence of lower vowel /a/ because of vowel height assimilation in Bengali. In spelling, confusion due to neutralization (which does not give the cue for the use of a long vowel for e.g., ভীড় *bheeRa* /bʰir/ 'crowd') accounted for 6.8%, 18.8% and 2.8% of errors in Grade 2, the LS, and the MS Grade 3-4 groups respectively.

5.3 The role of the inherent vowel and mapping for vowels /o/ and /ɔ/

Written Bengali does not distinguish between the vowels /o/ and /ɔ/: and are written without a diacritic marker. Bengali nevertheless has another vowel full form of ও and its diacritic ো which represents /o/. On the face of it, it may appear that children have no phonological cues for choosing between the two representations for /o/ (the unmarked inherent vowel and the marked ো diacritic). But it is word level phonology that decides which to use when. The unmarked form is used usually before a consonant cluster, and very few children make an error (altogether 6 such errors were recorded and here, children used the marked form in words where আপত্তি *aapatti* /apotti/ 'objection' and থাপ্পড় *thaappoRa* /tʰa:poɹ/ 'slap' were

[2] The nonword reading task has no item with geminates, therefore comparative scores on spelling and reading task are unavailable.

erroneously spelt as আপোত্তি and থাপ্পোড়). A word which was contrary to this pattern রোদ্দুর *raddura* /roddur/ 'sunshine' was spelled wrongly by many children: 9 in Grade 2, 3 in the lesser skilled Grade 3-4 group and 1 in the more skilled Grade 3-4 group. The sound /o/ in the first syllable of a monosyllabic word is indicated with the marked form. Younger children appeared to be slower to pick up this rule and used the unmarked form instead, e.g. সোন *sona* /ʃon/ 'listen!' was spelt as সন (8 such errors), with the unmarked form.

The impact of the ambiguity around the inherent vowel was seen in reading word final and medial consonants, particularly in Grade 2 and the lesser skilled Grade 3-4 group. The difficulty was in deciding whether to drop or retain the inherent vowel in reading a word medial akshara (Sircar & Nag, 2014)[3]. Interestingly, we find the word final consonant in nonwords also causing a similar confusion. Children read the last akshara in the nonword বিচিন *bichina* /bitʃin/ with the vowel /o/ as specified by orthography, though these errors were marginal, 2.2% in Grade 2 and 2.7% in the lesser skilled Grade 3-4 group. However, such errors in reading were not found in the word reading task. Neither did we find instances of children wrongly inserting a vowel diacritic ো in spelling words that end in akshara with a suppressed inherent vowel.

A rare but intriguing error was when পীরশা *pirashaa* /piroʃa/ was read as /poriʃa/ by 12 of the 109 children: Here, the first vowel shifts to the second syllable, and the first is reduced to the inherent vowel /ɔ/: $CV_{\alpha}CV_{\beta}$ > $CV_{\beta}CV_{\alpha}$. Such vowel-vowel metathesis is rare in natural languages (McCarthy, 1985), but some languages shows similar vowel compensation.[4] Such vowel shifts were not seen in nonwords, where both the first and second syllable had inherent vowels or non-inherent vowels. Such shifts were also not seen in spelling.

Some children (altogether 10) inserted a vowel /o/ in between in a CCV. For example, they

[3] In Sircar and Nag (2014) we showed that CVCaCV nonwords, such as দটকা *DoTaka* that could be read as /dɔtka/ or /dɔtoka/, are read as /dɔtka/ like a real word পটকা /pɔtka/ 'firecracker': More skilled children often rely on lexical and phonotactic information rather than akshara-phonology mapping rules.

[4] Hawu shows a form of vowel metathesis which is more of a phonotactic repair strategy or a speech lapse.

read তীপ্ *tipna* /ti:pno/ as /ti:pon/. It is interesting that children tended to insert /o/ rather than /ɔ/ in word medial positions, respecting the phonological distribution of /o/ and /ɔ/. Such insertions were not seen in CCV with a non-inherent vowel; for instance, no child read টেল্পী *telpi* /telpi/ as /telip/ or রগ্না *ragnaa* /rɔgna/ as /rɔgon/.

Children rarely reduced vowels to the inherent vowel in reading words, clearly indicating that children recognized all vowel diacritics and mapped them onto their phonological values. However, in spelling, some Grade 2 children used an akshara with an inherent vowel for an akshara with a ligatured vowel diacritic in more cases than the older learners (error rate: 1.6%, 1.6% and 0.30% respectively in Grade 2, LS Grade 3-4 and MS Grade 3-4 groups). Finally, CCV akshara with the long vowel /a:/ were more likely to be reduced to the inherent vowel than vowels with /u/ and /i/.

Table 3 presents a summary of vowel diacritic errors.

INSERT TABLE 3

A point to highlight is that the LS Grade 3-4 group was severely impacted by vowel length neutralizations in spelling (18.82%) and the suppression of the inherent vowel in reading (13.33%). In both cases, the phonology-orthography is insufficient for the task of decoding, and children needed to go beyond mapping to understanding of word level phonology, which is not always systematic and generalizable. In this they were poorer than the younger Grade 2 learners. Put differently, the younger but typically developing Grade 2 and the MS Grade 3-4 groups showed knowledge of word level phonology, and this supported their reading more than their spelling, while for the LS group, both spelling and reading vowels remained difficult.

5.4 Impact of phonological neutralization in consonants

Orthography does not reflect the phonological neutralizations that some consonants have gone through. As predicted, homophonous consonants were one of the major sources of substitution in the spelling task where the wrong sibilant, rhotic or nasal was used in words across groups. In the 16 words providing scope of such phonological neutralizations, the

pattern of errors was as follows: Grade 2: 22.63%; LS Grade 3-4: 18.75%; MS Grade 3-4: 10.96%). Most of the errors were made in the choice of the sibilants (স, শ ষ) and the rhotic (র and ড়). In reading, except for the rhotic /r/ being read as /ɹ/, phonological neutralizations showed little effect.

5.5 The CCVs

Reading and spelling of CCV akshara depend on knowledge beyond simple phonological-orthographical codes, and most often oral language indicates to a learner how specific clusters behave and how they influence the neighboring vowels and consonants. Some of the pressure points in gaining mastery are understanding of the visual layout of the consonants in a cluster, awareness (and representation) of the sonorous segment of a cluster, and knowledge of word level phonology, i.e., how a consonant in a cluster is pronounced and transcribed.

(i) Retrieving phonology from a visuo-spatial configuration: Unlike Hindi, Bengali arranges the consonants in a cluster in many ways. When the arrangement does not cue linearity, Grade 2 children impose a bottom-to-top linearity; treating the bottom as the first consonant, and the top as the second, particularly in nonwords where semantics does not come to the rescue. Therefore, the nonwords তেল্পী /telpi/, তীপ্ন /tipno/ and রগ্না /rɔgna/ get read as /tepli/, /tinpo/ and /rɔnga/, respectively, with lesser skilled group most affected by the lack of cues (40% errors) (compare: Grade 2 9.9% errors; More skilled Grade 3-4: no errors). What happens in spelling? We find that the lesser skilled group applies a simple linear rule (like in Hindi), i.e., left to right representation mirroring the phonological order, completely ignoring the various ways in which Bengali arranges consonants in a cluster. However, such a visual representation was not found in the MS group. Children figure out how specific clusters are represented in Bengali after some initial glitches.

(ii) Dropping sonorous consonants in a CCV: Children are known to drop the internal sonorous consonant in speech, and younger children in the study dropped them in reading a cluster and so did the lesser skilled group (Grade 2: 9.9%; LS: 8.8%) while the MS had few such omissions in the present study. However, interestingly, when nasals were dropped from a /pn/ or /gn/ cluster, the resultant sound was geminate (/tipno/ was read as /tippo/), quite in keeping with a language-specific trend of clusters with a silent consonant. In spelling, such

omissions accounted for 33.6% errors in Grade 2 learners, 19% errors in LS, and 8.8% in the MS group (in this analysis words with silent consonants were not included). When the akshara block was complex with more than two or three ligatures, the omissions appeared to be higher. For instance, the /r/ in /bhr/ ভ্রুক্ষেপ *bhrukshepa* /bhruk^{h}ep/ 'qualm' was dropped more often than for others: This is an instance where the visuo-spatial organization may also be adding a cognitive challenge to the task of spelling. Fewer drops were seen in all three groups in geminates which are phonologically transparent: Grade 2: 4.05%; LS Grade 3-4: 3.33% and MS Grade 3-4: 1.92%).

(iii) Clusters with an unvoiced consonant: In the spelling task, unvoiced consonants in a cluster were routinely dropped (Grade 2: 54.05%; LS Grade 3-4: 52.22%, and MS Grade 3-4: 28.94%) since children used only the primary level of representation, i.e., the phonological-orthography mapping, which was not sufficient for the purpose. In medial CCVs with /j/ as the secondary consonant, children produced a geminated cluster. For example, in তাচ্ছিল্য *tacchilya* /tatʃtʃ^{h}illo/ was spelled as তাচ্ছিল্ল, showing a tendency to assume that all phonological information is contained within the akshara rather than distributed akshara representing the phonology across the word. Spelling geminates with /Cy/ rather than /CC/ were not seen in other high frequency words in the test.

(iv) A conjunct or two full akshara: Two different ways of representation may result in a phonological consonant cluster as a conjunct or two full akshara. In the reading test, both forms were available in the target items. As described earlier, children had little difficulty in figuring out that both forms may lead to a CCV (except those read analogically as CVCVCV) In the spelling task, though no target CCV item was spelled with two full akshara, children were found to write select items /mɔnt^{h}on/, /roddur/ and /t^{h}appor/ with two full akshara rather than a conjunct (G 2: 2.27%; LS G 3-4: 3.2%; and MS G 3-4: 0.98%). A medial CCV akshara usually gets torn apart and phonologically encoded as CVC.CV with a closed syllable followed by an open/closed syllable (Sircar & Nag, 2014). Children were more likely to write the cluster with two full consonants when it resulted in a CVC.CVC rather than CVC.CV. Table 4 summarizes the discussion on consonant errors so far.

INSERT TABLE 4

The varied akshara-phonology associations that are reported in many other akshara languages (Bright, 1996; Nag, 2013) interacts with spelling and reading acquisition in beginning learners of Bengali. While phonological neutralizations impact spelling more than reading, inconsistent mapping and visual complexity in CCV impact both reading and spelling. A point that becomes clear is that to circumvent inconsistencies in phonology-orthographic links, children need to move beyond the phoneme and syllable (which are sub-lexical and thus not affected by word boundaries) and understand phonological rules that apply at the level of the word or lexical unit. For instance, spelling CCVs with unvoiced segments requires more fine-tuned knowledge of phonology (nasalization, germination, or vowel length with reference to the position of the cluster in the word) which can cue the learner to the presence of an orthographic segment.

6. Going beyond: Word level phonology

The intention in the present study was to explore language specific features, such as vowel and consonant neutralization, the inherent vowel, and how consonant clusters impact reading and spelling in different ways. In neither task is the mere knowledge of phonological-orthographic mapping sufficient.

Briefly, what we have found are the following:

(i) Reading and spelling performance increased rapidly in the first two years of schooling, and this result is in line with findings in other alphasyllabic orthographies. Grade 2 children achieved 96% accuracy for reading words with taught akshara and 84% accuracy for reading nonwords. A particular area of rapid mastery is knowledge about the unmarked inherent vowel. Familiarity pulls children out of the inherent vowel puzzle when in a word, but where the vowel is underspecified in the printed nonword, decoding becomes tricky. The way to read these items would be to read by analogy, or with the help of word level knowledge (position, vowel context, etc.): The inherent vowel is pronounced as /ɔ/, or /o/, or is suppressed. Therefore, children go beyond simple principles of mapping, and we argue that most of such word level

phonological learning is derived from exposure and use of oral language. Those who are able to tune in to these phonological nuances succeed in reading, whereas the others fall back on taught linkages and overextend these akshara-sound correspondences to contexts that are, in fact, not permissible. In spelling, children additionally need to understand the language specific orthographic conventions within a word with respect to the inherent vowel which is governed by position (e.g., /o/ in a word initial syllable is represented with a diacritic, and /ɔ/ without) and type of akshara preceding or following them.

(ii) The assembly of spelling, particularly, is made complex by phonological neutralizations, where the phonological information is insufficient for the purpose. Because of phonological neutralizations of both consonants and vowels, the inventory of phonemes in Bengali has been whittled down to a smaller set though orthography stubbornly preserves all these once-distinct phonemes. Nevertheless, the orthography makes up for this spelling difficulty by simplifying the task of reading. The only way in which a speller can assemble the right spelling is by bypassing underspecified phonological information. Frequency of reading exposure and use of specific words in writing can play a contributive role here but may not be productive for low frequency words and nonword spelling.

(iii) A cluster, where a consonant is not voiced, is a test case of what children have learned about Bengali phonology. It is not only the phonological presence or absence of a sound in a word that needs to be noted and represented, but also how a segment changes other phonological features in the word: They may introduce new segments (like germination), or substitute one segment with another (nasalization, vowel lengthening). If these are used as cues, then children would infer the presence of an unvoiced segment, and be able to orthographically represent it. Since these rules pertain to only specific clusters and are not productive (i.e., they cannot apply to (recently) borrowed words), they are slower to be acquired.

In conclusion, we have shown that Bengali has its own distinctive orthography with homophonous consonants and vowels, complex graphemic expression of CCVs, inconsistent

pronunciations, and ambiguous representation of the inherent vowel: These may be learned only if one goes beyond the usual mapping that literacy instruction typically provides. Delving into distributed word level phonology is also clearly important for Bengali literacy development, and advancing towards mastery is dependent on substantial exposure to print and a language-rich environment

References

Alcock, K. J., & Ngorosho, D. (2003). Learning to spell a regularly spelled language is not a trivial task-patterns of errors in Kiswahili. *Reading and Writing: An Interdisciplinary Journal,* 16: 635-666.

Bright, W. (1996). The Devanagari script. In P. T. Daniels & W. Bright (Eds.), *The World's Writing Systems* (pp. 384–390). New York: Oxford University Press.

Chatterji, S. K. (1926). *The origin and development of the Bengali language* (Vol. 1). Calcutta: University of Calcutta.

Dan, M. (1992). *Some issues in Metrical Phonology of Bangla: the indigenous research tradition.* Ph.D. dissertation, University of Poona, Pune.

Dasgupta, P. (2003). Bangla. In G. Cardona & D. Jain (Eds.), *The Indo-Aryan languages* (pp. 351–390). London: Routledge.

Geva, E., Wade-Woolley, L. and Shany, M. (1993) The concurrent development of spelling and decoding in different orthographies. *Journal of Reading Behavior*, 25: 383–406.

Hai, M. A. (1975). Dhonibiggan o Bangla dhonitatto. Dhaka: Barnamichil.

Kar, S. (2010). *Syllable Structure of Bangla: An Optimality Theoretic Approach*. Newcastle: Cambridge Scholars.

Kishalaya, Book 1, 2. (2004). Paschim Banga Vidyalaya-Shiksha Adhikar, Kolkata.

Mathur, C. & Nag, S. (in press). Language-focused Instruction for Literacy Acquisition in *Akshara*-based Languages: Pedagogical Considerations and Challenges. In M. Joshi, & C. McBride, (Eds). *Handbook of Akshara Languages*. Springer.

Majumdar, A. (1997). *Bhasha Tatva*. Kolkata: Naya Prakas

Masica, C. P. (1991). *The Indo-Aryan languages.* Cambridge: Cambridge University Press.

McCarthy, J. J. (1985). *Formal Problems in Semitic Phonology and Morphology*. Garland, New York.

Nag, S. (2007). Early reading in Kannada: The pace of acquisition of orthographic knowledge and phonemic awareness. *Journal of Research in Reading*. 30(1) 7-22.

Nag, S. (2013). Low Literacy Attainments in School and Approaches to Diagnosis: An Exploratory Study. *Contemporary Education Dialogue*. 10(2) 197-221.

Nag, S. (2014). Akshara-phonology mappings: the common yet uncommon case of the consonant cluster. *Writing Systems Research*, 6(1): 105-119.

Nag, S. (2017). Learning to read alphasyllabaries. In K Cain, D. Compton, R. Parrilla (Eds.). Theories of Reading development. Amsterdam: John Benjamins.

Nag, S. & Narayanan, B. (under review). Orthographic knowledge, spelling and reading development in Tamil: the first three years. In M. Joshi, & C. McBride, (Eds). *Handbook of Akshara Languages*. Springer.

Nag, S. & Sircar, S. (2008). *Learning to Read in Bengali: Report of a Survey in Five Kolkata Primary Schools*. Bangalore, India: The Promise Foundation.

Nag, S., Treiman, R., & Snowling, M. J. (2010). Learning to spell in an alphasyllabary: the case of Kannada. *Writing Systems Research*, 2(1), 41–52.

Ohala, M. (1983). *Aspects of Hindi Phonology*. New Delhi: Motilal Banarasidass.

Pandey, P. (1990). Hindi schwa deletion. *Lingua*, 82:277-311.

Pandey, P. (2007). Phonology-orthography interface in Devanagari for Hindi. *Written Language and Literacy,* 10(2): 139-156

Pandey, P. (2014). Akshara-to-sound rules for Hindi. *Writing Systems Research*, 6(1): 54-62.

Patel, P. G. (2004). *Reading acquisition in India: Models of learning and dyslexia*. New Delhi: Sage.

Patel J., Bapi, R.S., & Nag, S. (2013). *Akshara counts in child directed print: A pilot study with 101 texts.*

Rahbari, N., Sénéchal, M., & Arab-Moghaddam, N. (2007). The role of orthographic and phonological processing skills in reading and spelling of monolingual Persian

children. *Reading and Writing: An interdisciplinary Journal,* 20*:* 511-533.

Sarkar, P. (1986). *Aspects of Bengali syllables.* Paper presented at the National Seminar on the Syllable in Phonetics and Phonology, Hyderabad. Osmania University.

Shapiro, M. C. (2007). Hindi. In G. Cardona & D. Jain (eds.), *The Indo-Aryan Languages* (pp. 250- 285). London: Routledge.

Sircar, S., & Nag, S. (2014). Akshara-syllable mappings in Bengali: A language-specific skill for reading. In H. Winskel & P. Padakannaya (Eds.), *South and Southeast Asian psycholinguistics* (pp. 409-425). Cambridge University Press.

Sprenger-Charolles, L., Siegel, L. S., & Bonnett, B. (1998). Reading and spelling acquisition in French: The role of phonological mediation and orthographic factors. *Journal of Experimental Child Psychology*, 68: 134-165.

Tiwari, S., Nair, R., & Krishnan, G. (2011). A preliminary investigation of akshara knowledge in the Malayalam Alphasyllabary: Extension of Nag's (2007) study. *Writing Systems Research,* 3(2): 145–151.

Vaid, J., & Gupta, A. (2002). Exploring word recognition in a semi-alphabetic script: The case of Devanagari. *Brain and Language*, 81: 679–690.

Wijayathilake, M. A. D. K. & Parrila, R. (2014). Predictors of word reading skills in good and struggling readers in Sinhala. *Writing Systems Research, 6,* 120-131.

Wijayathilake, M. A. D. K., Parrila, R., Inoue, T. & Nag, S. (in press). Instruction matters to the development of phoneme awareness and its relationship to akshara knowledge and word reading: Evidence from Sinhala. *Scientific Studies of Reading.*

Winskel, H. & Iemwanthong, K., (2010). Reading and spelling acquisition in Thai children. *Reading and Writing: An Interdisciplinary Journal, 23(9):1021-1053.*

Table 1: Consonant clusters and their phonological realizations in Standard Bengali

Cluster	***Pronunciation***	***Example (with unpronounced consonant in bold)***	***Effect on syllable***
Word initial clusters with unpronounced consonant			
স্ম [sm]	/s/	স্মৃতি *sm**r**iti* /srĩti/ 'memory'	nasalizes following vowel
স্ব [sv]	/ʃ/	স্বাস / *sv**a**sa* ʃa:ʃ/ 'breath'	lengthens following vowel
ত্য [ty]	/t/	ত্যাগ *t**y**aga* /tæg/ 'sacrifice'	raises the vowel from /a/ to /æ/
ক্ষ [ks]	/$k^{h/}$	ক্ষমা *k**sh**ama* /k^{h}ɔ:ma/ 'pardon'	lengthens following vowel
Word medial clusters with unpronounced consonant			
ত্ব [tv]	/tt/	তত্ব *tat**v**a* /tɔtto/ 'material'	geminates primary consonant
দ্ম [dm]	/dd/	পদ্মা *pad**m**a* /pɔdda/ 'lotus'	geminates primary consonant
ক্ষ [ks]	/$k^{h}k^{h}$/	শিক্ষা *shik**sh**a* /ʃik^{h}k^{h}a/ 'education'	geminates primary consonant
হ্ন [hn]	/nn/	চিহ্ন *chi**h**no* /tʃinno/ 'sign'	geminates secondary consonant

Table 2: Comparison of accuracy on reading and spelling across three groups

Measure	***G 2 (37)***	***LS G 3-4 (15)***	***MS G 3-4 (57)***	***Mann-Whitney U and post hoc tests***
Word reading	96.92 (*0.83*)	98.21 *(0.59)*	99.63 *(0.21)*	264.26 ($p < 0.01$) G2 < LS G3-4 < MS G3-4
Nonword Reading	83.67 *(2.71)*	80.92 *(2.06)*	91.67 *(1.32)*	273.39 ($p < 0.01$) LS G3-4 < G2 < MS G3-4
Spelling	57.56 (*4.79*)	55.76 *(5.22)*	76.76 *(0.58)*	458.48 ($p < 0.01$) LS G3-4= G2 < G3-G4

Note: G2 = the Grade 2 average performing group; LS G3-4 = the lesser skilled Grade 3-4 group; MS G3-4 = the MS Grade 3-4 group.

Table 3: Percent errors in reading and spelling vowels

Type of errors	***Example***	***Nonword Reading***			***Word Spelling***		
		G 2	LS G3-4	MS G3-4	G 2	LS G3-4	MS G3-4
Vowel length (12 akshara in nonword reading;17 akshara in spelling)	ভীড় /bʰi:ɹ/ 'crowd' as ভিড় /bʰɪɹ/	–	–	–	6.83%	18.82%	2.78%
Marked for unmarked for /o/ before or after CCV (8 akshara)	থাপ্পড় *thaappoRa* / tʰa:poɹ/ 'slap' as থাপ্পোড়	–	–	–	1.09%	0.83%	0
Inherent vowel for suppressed vowel in coda (7 akshara; 18 akshara)	বিচিন *bichina* /bitʃin/ as /bitʃino/	5.41%	13.33%	1%	–	–	–
Inherent for vowel diacritic (34 akshara with diacritics)	পুরুষ /puruʃ/ 'man' as পরুষ /poruʃ/	–	–	–	3.73%	2.74%	0.72 %
Vowel shift (6 words)	পীরশা *pirasha* /piroʃa/ *as* /poriʃa/	0.90%	2.22%	0.23%	–	–	–
Vowel insertion in clusters* (6 CCVs)	তীপ্ন *tipna* /tipno/ as /ti:pon/	1.35%	3.33%	1.16%	–	–	–

*In spelling children split the consonant cluster: we report them in the CCV section.
Note: G2 = the Grade 2 average performing group; LS G3-4 = the lesser skilled Grade 3-4 group; MS G3-4 = the MS Grade 3-4 group.

Table 4: Percent errors in reading and spelling consonants

Type of errors	***Examples***	***G 2***	***LS G3-4***	***MS G3-4***	***G 2***	***LS G3-4***	***MS G3-4***
Phonological neutralization (5 nonwords; 16 words)	ভীড় /bʰiɹ/ 'crowd' as ভীর /bʰir/	3.24%	12%	1.7%	22.63% %	18.75%	10.96%
Omitting sonorous consonants in CCV (3 nonwords; 7 words)	রগ্না *ragna* /rɔgna/ as /rɔgga/ পরিশ্রান্ত *parishantra* /porisranto/ as /porisanto/	9.90%	8.8%	0.2%	33.6%	19%	8.8%
Omitting consonants in geminates (10 words)	আপত্তি *apatti* /apotti/ 'dissent' as আপতি /apoti/	--	--	--	4.05%	3.33%	1.93%
Silent consonant in CCV (5 words)	স্মরনিয় *smaraniya* / *s*ɔronijo/ 'memorable' as সরনিয়	--	--	--	54.05%	52.22%	28.94%
Full akshara for CCV (25 CCVs)	মন্থন manthana / mɔnthon/ ' as মনথন	–	–	–	2.27%	3.2%	0.98%

Note: G2 = the Grade 2 average performing group; LS G3-4 = the lesser skilled Grade 3-4 group; MS G3-4 = the MS Grade 3-4 group.

Author(s) Information

Shruti Sircar
Professor, Department of Linguistics & Contemporary English
School of Language Sciences
English and Foreign Languages University
Hyderabad 500 007
Telangana
India
email: shrutisircar@efluniversity.ac.in

Sonali Nag

University of Oxford, OX4 6PY.