

LITERACY DEVELOPMENT IN THE ALPHASYLLABARIES – IMPLICATIONS FOR CLINICAL PRACTICE

Alphasyllabaries and Atypical development¹

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Our understanding of reading development and its disorders by and large converge on alphabetic languages. However, a recent upsurge in reading research on non-alphabetic languages has remarkably influenced our perception of reading mechanism. Reading is now described as a multi-component system involving a range of cognitive skills, with its development varying across languages according to transparency of the orthography (McDougall, Brunswick, & Davies, 2010). Yet reading research in alphasyllabaries is largely silent.

Alphasyllabic writing presents a special case as it shares the properties of alphabetic and syllabic writing systems. Hence, the grapheme in an alphasyllabary (known as *akshara*) can map onto either a phoneme or a syllable. The script to sound mapping in alphasyllabaries is more or less consistent in nature. South Asian scripts, particularly Indian scripts for example Kannada, Hindi, Tamil, Malayalam etc. belong to this category. A striking feature of alphasyllabic script is that the vowel sounds are represented in primary form when used in word initial position else is represented using a secondary form called as diacritic marker attached to the base consonant. This in turn requires children to learn several ligaturing rules in order to decode the script. This paper presents a summary of research on reading development and disorders in various alphasyllabic languages drawing implications for clinical practice.

Contemporary research indicates that both universal and script specific aspects operate while reading a particular script in typical and reading impaired individuals. A recent intervention study provided evidence on the universal accounts of reading. **Fletcher Flinn and Thompson (2011)** for example, in their lexical training experiment showed that young Japanese children (5 years old) transferred and learned untrained words in hiragana, representing different secondary phonemic elements. Hiragana is a syllabic script and children reading this script essentially learn to map the Hiragana syllabograms to syllables in spoken language. This

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rapid shift in reading Hiragana at syllable level to dual use of Hiragana representing phonemic level in spoken language thus, fails to provide support to theories requiring explicit letter-sound training to induce phonemic representations in the orthography. This, in turn provides support to implicit learning of a formation principle for secondary (phonemic) use of Hiragana thus, accounting for reading acquisition in different languages and orthographies.

Reading in the *alphasyllabary writing system* is similar to reading in other writing systems, requiring the engagement of phonological processing and the broader language system. However, at the script-specific level, syllable-level processing and possibly a greater role for visual processing skills in alphasyllabary literacy development is beginning to be documented (Nag, Caravolas & Snowling, 2011; Kim & Petscher, 2011; Kumar et al., 2010). Alphasyllabaries rather distinguish themselves from alphabets and align with the logographies in terms of the longer learning phases that are required for the complete acquisition of the symbol set (Nag, 2007; Nag, Treiman & Snowling, 2010; Tiwari, Nair & Krishnan, 2011). In fact, the very nature of the Indian alphasyllabaries (i.e., akshara mapping to both syllable and phoneme levels) has been reported to influence the phonological development wherein orthography pre-dominantly support syllabic awareness, and a gradual emergence of phoneme awareness (Nag, 2007; Nag & Snowling, 2011).

Written Bengali like other alphasyllabaries follows a regular orthography wherein akshara more or less consistently map to spoken syllables or phonemes. However, some phonemes in Bengali (for example, /ʃ/, /n/, /dʒ/, /j/ etc.) may be represented using more than one akshara. Therefore, a given word in Bengali can have more than one spelling. Such spelling variations though could only be resolved using word specific knowledge of form and meaning (and not phonological knowledge), that comes with practice. This particular attribute of Bengali orthography, thus renders learning to spell more difficult than learning to read. **Sircar and Nag (2011)** investigated spelling and reading skills in a sample of 109 primary grade children (mean age 6 – 9 yrs) involving good as well as poor readers. Children were given spelling, word and nonword reading tasks. Results of the study showed that spelling errors in children learning Bengali script continued till grade 4. These spelling errors were largely phonological in nature reflecting akshara substitutions and omissions at syllabic levels. Spelling errors were observed to be more for words with complex akshara structures (CCVs). In general, children's performance on word reading was superior to word spelling. Findings of this study therefore unravel the complex orthographic rules in otherwise quite regular Bengali alphasyllabary. Authors therefore draw the attention of educators and teachers towards teaching complex orthographic conventions using a range of spelling exercises.

Hindi written in Devanagari script is yet another interesting orthography wherein the vowel diacritics may be attached to the base consonant at different locations (for example,

MüÉ /ka:/ 'É' diacritic to the right of consonant, ÌMü /ki/ 'Ì diacritic to the left of consonant, MÑü /ku/ 'Ñü' diacritic below the consonant, Måü /ke/ 'åü' diacritic above the consonant) thus giving rise to nonlinear and visually complex appearance to the script. This particular feature of the script was exploited by **Singh and Rao (2011)** to investigate the word processing in the nonlinear Hindi alphasyllabary to understand the reading network at the cortical level. Sixteen right handed adults aged 21 to 46 yrs participated in the study. Stimuli comprised of 120 Hindi words presented in 12 alternating blocks of 20 linear and nonlinear words (10 each). Stimuli were presented using E-prime software compatible with IFIS. Stimulus words were 240 nouns with 120 linear and nonlinear words each on the basis of the vowel diacritics positioned either on (e.g., UÉiÉ /ra:t/ i.e., night) or above/below (e.g., UáiÉ /ret/ i.e., sand) the central plane of text respectively. fMRI scanner acquired thirty axial T2 slices making around 160 volumes per participant. The data analysis was performed using SPM5 toolbox. Group-level cortical activations were compared with baseline (rest block) for linear and non-linear words separately. Results showed that reading in Devanagari was characterized by robust activations in the occipito-temporal regions, superior temporal gyri (BA21) and cerebellar regions in both hemispheres. Common areas of activation while reading linear and nonlinear Hindi words included frontal regions in the left precentral gyrus (BA4) and supplementary motor area (SMA, BA6). However, the reading network differed significantly for reading of linear vs. nonlinear words in terms of increased activation in the right hemisphere, particularly in the middle temporal gyrus and occipito-temporal regions. Findings of the study are thus suggestive of a bilateral reading network for Devanagari in contrast to primarily left lateralized word reading network reported in alphabetic scripts. Authors attributed these additional activation patterns while reading of nonlinear Hindi words to increased visual processing demands arising as a result of complex visuo-spatial arrangement of Devanagari akshara.

Accordingly, **Prema (2011)** posited that precursors to literacy in alphasyllabaries are governed by script structure, through a series of studies exploring the development of phonological awareness in three South-Indian Dravidian languages, and two studies on training of phonological awareness and print literacy in Indian children learning English as a second language. Prema and her associates studied reading acquisition in children learning to read in Kannada (Prema, 1997), Tamil (Akhila & Prema, 2000) and Malayalam (Seetha & Prema, 2002) alphasyllabaries. Collectively, Prema claimed that precursors (phonological awareness and oral language) to literacy emerge as a consequence of script awareness (written language awareness). Based on the findings, Prema proposed a model for precursors to literacy acquisition in ESL children wherein, written language awareness with oral language and phonological awareness skills support the development of reading skills. She further recommended future research to explore cognitive processes essential for early literacy skills in bilingual/biliterate children in Indian context.

The issue of biliteracy in Indian context was addressed by **Tiwari, Krishnan, Rajashekhar and Chengappa (2011)**. Tiwari et al. investigated the reading acquisition in Malayalam-English biliterates learning to read and write two distinct writing systems alphasyllabic and alphabetic at the same time. A total of 210 children, 30 each from grade 1 to 7 participated in the study. Participants' performance was assessed on phonological awareness, word and nonword reading and orthographic knowledge tasks in each language. Phonological awareness task involved sections like rhyme recognition, syllable deletion, phoneme deletion and phoneme oddity. Reading tasks required children to read words and nonwords in each language, stimuli for which was prepared by pooling several words from grade textbooks followed by familiarization rating carried out by the school teachers. Nonwords were generated from true words by transposing either vowels or consonants without violating the phonotactic rules of the language. Orthographic knowledge task checked for both recognition and recall of letter/akshara in the two languages. Akshara recall in particular checked for types like vowels in primary form, consonants with inherent vowel, consonant ligatures, chilaksharam (consonants without inherent vowel), and consonant conjuncts (i.e., consonantal diacritics oriented in vertical and horizontal plane). Findings of the study showed a developmental trend for all the skills – phonological awareness, reading words and nonwords and orthographic knowledge in both languages. Significant main effects of grade and language were obtained for all the tasks. Further an interaction of grade and language was also obtained for all the tasks. Development of phonological awareness showed apparent differences across languages with gradual emergence of phonological knowledge in Malayalam language. Within the phonological awareness tasks also, differences in maturation were observed across languages wherein rhyme recognition and syllable deletion matured earlier (grade 3) compared to phoneme deletion and phoneme oddity (continued to mature till grade 7 with the latter not reaching 50% maturation by grade 7). Word reading matured early in both languages though it was significantly better in Malayalam. An interaction between grade and language was found to be significant for word reading task. Similar developmental trend was observed for nonword reading also, with word reading superior to nonword reading. Development of orthographic recognition preceded recall skills in both languages, the later varying as a function of letter/akshara complexity. Akshara recognition reached near maturation by grade 1 itself, which was followed by lower case and upper case (grade 3) letter recognition. A significant interaction was obtained between grade and language of reading. Development of orthographic recall in Malayalam was significantly poorer than in English with significant interaction between grade and language. Letter recall showed a clear developmental pattern wherein clusters matured only by grade 5 in contrast to upper and lower case letters. Akshara recall too showed a distinct pattern of emergence with simple akshara like vowel in primary form, akshara with inherent vowel and akshara without inherent vowel (chillu) matured earlier than more difficult akshara types like consonants with vowel ligatures, consonant conjuncts and

clusters maturing only by grade 4. In sum the study provides preliminary evidence for differential pace of acquisition of literacy skills in children learning to read and write in two distinct languages and writing systems – alphasyllabic and alphabetic – in parallel. The gradual emergence of phonological awareness and orthographic knowledge in Malayalam probably reflects the influence of orthography to phonology mapping. Further superior word reading in Malayalam reflects the influence of orthographic depth.

Studies on impaired reading in alphasyllabaries like Kannada, Bengali and Hindi have shown primary deficits in akshara knowledge and phonological processing with additional difficulties in the areas of oral language, rapid naming and visual processing skills (Nag & Snowling, 2011). Another significant area of difficulty for children with dyslexia in Indian alphasyllabaries, lies in following rules of orthography and construction of complex syllables (Gupta, 2002; Gupta & Jamal, 2006; Purushotama, 1994). Ramaa (1993) documented that poor readers in Kannada exhibited errors related to difficulties with short versus long vowels, nasals and simplification of gemination, in addition to problems in word synthesis. Vaid and Gupta (2002) claimed that the disparity between the spatial and temporal sequencing of vowel signs in Devanagari (the *matra* feature of the script) incurs processing cost in terms of speed and accuracy in Hindi reading; and leads to one of the main locations for errors among poor readers of Hindi. **Narayanan (2011)** tested the hypothesis if poor readers in Tamil differed from good readers on measures of orthographic knowledge and automaticity (speeded naming). A total of sixty, grade III (mean age of 8 yrs) children from Tamil medium schools participated in the study. These children were grouped as low and high achievers (thirty each) upon teacher's rating. Seventy one familiar words selected from grade I textbook were the stimuli for this study, comprising of various consonants and consonants with vowel ligatures. Stimulus was presented through computer installed with DMDX software, with each word displayed for 1 second duration. Participants were instructed to quickly read the words as accurately as possible. Stimuli that received incorrect and no responses were presented again to the participant later on for long period without any time restrictions. A significant difference was observed between good and poor readers for the automaticity (speeded naming) task. On leisure reading however, both good and poor readers could read the missed words, though better by the former group. Poor readers were also slower in reading words. In particular, poor readers had difficulty reading words in Tamil with irregular orthography. For example, two akshara having visual similarity ($f /dʒʌ/$ and $^3 /ai/$), single akshara read as different syllables ($¶ /au/$), and akshara with complex vowel ligaturing rules like ($!Á^a /mau/$). Author thus concludes that a test of orthographic knowledge could help identify and differentiate poor readers, and in identifying the nature of reading errors. Preliminary observations made in another alphasyllabary, Malayalam, showed that phonological awareness, akshara knowledge, working memory and reading speed predicted reading accuracy in good and poor readers (Remya,

2010). These evidences therefore point to the fact that orthographic knowledge seems to be a critical measure in identification of poor readers in alphasyllabic writing. Thus on the whole, as true for alphabetic languages, phonological processing seems to be the core deficit in the reading impaired learning to read alphasyllabaries. Additionally, children with reading difficulties learning to read in an alphasyllabary show an overall delay in reading and spelling, though their profile is similar to typically developing children.

Few studies reported phonological skills and reading assessments in atypical populations like cerebral palsy and hearing impairment. **Selvakumar (2011)** investigated metaphonological abilities in Kannada speaking verbal children with cerebral palsy. Cerebral palsy is a medical condition that affects muscle coordination and therefore speech intelligibility. Hence, speech production better predicts reading skills and facilitates the phonological awareness abilities in this population (Peeters, Verhoeven, Moor & Balkom, 2009). Author thus hypothesized that verbal children with cerebral palsy will perform as well as typically developing peers on metaphonological tasks. A group of 12 verbal children (mean age 13 yrs; language age > 8 yrs, literacy experience of 6.25 yrs) with cerebral palsy having IQ > 80 were compared with language-matched typically developing children (mean age 8.5 yrs and literacy experience of 3.8 yrs) on metaphonological tasks like rhyme recognition, syllable stripping, syllable oddity (words and nonwords), phoneme stripping and phoneme oddity (nonwords) taken from Prema (1997). Results indicated that children with cerebral palsy performed poorly on all tasks of metaphonological skills though reached significance only for syllable oddity (for nonwords) and phoneme stripping tasks. Author attributed poor performance on syllable oddity (nonwords) to limited ability in exploiting the articulatory loop and difficulty in remembering novel phonological strings (Bishop & Robson, 1989) in children with cerebral palsy. Poor performance on phoneme stripping task by children with cerebral palsy was however attributed to insufficient exposure to Kannada orthography followed in the special school curriculum.

Kavita and Venkatesh (2011) on the other hand investigated the influence of primary mode of communication on phonological awareness and reading skills in prelingual hearing impaired children (age range 6 – 7 yrs) learning Kannada alphasyllabary. Two different groups of prelingual hearing impaired children using two different communication modalities – oral aural mode of communication and total communication were compared with control normal hearing children matched for age and grade levels. Participants were assessed on a range of phonological awareness tasks including rhyme recognition, syllable segmentation, syllable deletion and phoneme deletion using picture stimuli. Responses were elicited using verbal instructions supported with gestures for hearing impaired children using total communication mode. Reading abilities were assessed using tests like Reading Readiness Test (RRT; Devaki Devi, 1978) and reading subsections of Reading Acquisition Profile-Kannada (RAP-K, Prema, 1997). Results of the study as expected revealed that hearing impaired children using

total communication approach performed poorer on phonological awareness and reading tasks in comparison to hearing impaired children using oral aural approach, which in turn was poorer than performance of age matched and grade matched controls. Both hearing impaired children using oral aural approach and normal hearing grade matched controls performed equally well on rhyme recognition though poorly on phoneme deletion task. On syllable awareness tasks like syllable segmentation and syllable deletion and reading tasks however, children with hearing impairment using oral aural approach for communication performed better than normal hearing grade matched controls. The findings of the study therefore suggest that the primary mode of communication in children with hearing impairment impacts the development of phonological awareness and reading skills. Hence, early experiences with spoken language for perception and production purposes in children with hearing impairment using oral aural mode of communication may facilitate phonological awareness and reading skills when compared to hearing impaired children using total communication. Authors of the study conclude by stating that syllable awareness training is an effective measure which facilitates reading skills development in alphasyllabic orthography. Authors are currently investigating the effect of training phonological and orthographic awareness on development of reading abilities in hearing impaired children using total communication mode in an intervention study. Future studies exploring the use of cueing and finger spelling strategies on phonological awareness development in hearing impaired population is recommended.

One of the intervention studies addressed reading difficulties in children with English as second language. **Sarkar (2011)** investigated the effectiveness of two reading strategies in a group of 177 10 – 11 yrs old children with reading difficulties studying in Bengali medium mainstream schools of Kolkata. Participants were randomly assigned to experimental group 1 or 2 to receive either intervention 1 (a non-phonetic treatment focusing letter name and its combination to help reading) or intervention 2 (a phonetic-based treatment emphasizing on letter sounds, sound awareness, consonant blends and onset-rime) for 45 minutes sessions thrice a week for a period of 8 months by the school teachers. A third group formed the control group wherein participants with reading difficulties did not receive any intervention but classroom teaching. Reading intervention was provided only in English language. 1-Minute reading test was administered as a pre-test and post-test for measurement of progress in reading skills. Pre-Post-test comparisons revealed significant improvements for participants of group 2 that received phonetic-based treatment from group 1 and control group that received non-phonetic based treatment and no treatment respectively. The author thus concluded that phonetic based strategy is useful to remediate reading difficulties in ESL children.

Emerging literature on literacy development in alphasyllabaries has several implications for clinical practice. Keeping in mind the cognitive processes particular to the orthographic unit of the akshara, assessment and intervention for poor readers in alphasyllabic scripts is expected

to be different from that of alphabetic scripts. For example, Nag and Snowling (2011) recommended inclusion of the following tasks in the assessment battery aiming to identify reading difficulties in akshara languages: akshara knowledge, reading accuracy, reading comprehension, spelling, syllable processing, oral language processing, reading speed, phoneme processing, speed of processing, and visual sequential processing. Further, Nag and Snowling (2011) through a multifactorial model of reading development, proposed assessment of reading accuracy, reading rate and reading comprehension for identification of reading difficulties. The authors suggested that performance on domains like akshara knowledge, phonological processing, broader oral language, naming speed and visual memory interact to produce a spectrum of delays and difficulties among poor readers. They also recommended that akshara recognition and syllable processing tasks are essential for the identification of reading difficulties even in older children. The knowledge of orthographic principles underlying the alphasyllabaries is another sensitive test differentiating good readers from poor readers in Kannada (Karanth, 2003). The phonological and orthographic structure of a given language influences reading development. Unlike alphabetic languages, assessment of orthographic knowledge in alphasyllabary is particularly difficult owing to mismatch of phonological to orthographic syllable, hence rendering segmental manipulation not possible for words with consonant clusters. **Vasanta (2011)** developed a method to investigate interaction of phonology and orthography in processing Telugu words with two consonant clusters (for the word '*goorlu*', i.e., nails) in children from fourth and sixth grade. The task required segmenting individual components of clusters (*ru* and *lu* in the case of *goorlu*) in word and nonword context, by isolating the shared vowel phoneme (-*u*-) and subsequently generating another word by deleting one segment of each cluster (*gooru* by deleting the segment -*lu*). The proposed task employs knowledge of both phonological awareness and orthography to segment individual cluster components and isolating the vowel, and to recover the second component of cluster using secondary grapheme. This method was validated on a group of 20 children from fourth and sixth grade. Results showed a developmental trend for the responses in terms of number of errors and time taken to respond. The task performance was however not influenced by the sonority features of stimuli used in the study. Vasanta (2011) recommended future research in terms of developing linguistic corpora addressing features of syllable frequency, phonologic and orthographic neighbors to be used for studies on lexical processing.

Given below is a selection of indigenous language-based reading assessments:

- *Reading Acquisition Profile in Kannada (Rap-K)* by Prema (1997) includes tests for oral language, phonological awareness, reading and writing, orthographic principles and reading comprehension skills.

- *Literacy Acquisition Battery* (LAB) developed at The Promise Foundation (LAB, 2011) comprises of a range of Kannada literacy and cognitive tasks like akshara knowledge, reading fluency, reading comprehension, spelling, expressive written language, vocabulary and phonological memory. The 'akshara knowledge' section of the battery has been adapted in other alphasyllabaries like Malayalam (Remya, 2010; Tiwari, Nair & Krishnan, 2011) and Bengali (Nag & Sircar, 2008).
- *Hindi Word Reading Test* by Gupta (1997) contains words of varying spoken frequencies and orthographic complexities.

Taken together, the implications for reading intervention in the Indian alphasyllabaries are clear – prioritize akshara instruction. Karanth (2003) recommended training orthographic principles and its application to compose and decompose graphemes for spelling construction. Likewise, Nag, Treiman and Snowling (2010) recommended precise teaching of akshara construction from its constituent elements of consonants and vowels to enhance spelling skills in Indian alphasyllabaries. Gupta and Jamal (2006) proposed the use of a phonics approach to help poor Hindi readers learn akshara-sound correspondences for Hindi. For Bengali, Nag and Sircar (2008) recommended promoting knowledge of akshara-in-words, teaching spelling and vocabulary instruction for improving reading skills. However, a comprehensive program to support reading skills should also include phonological games, vocabulary, other oral language skills and exposure to multiple texts (Nag & Snowling, 2010). Emphasis should also be given on interpreting meaning or comprehension of written material during acquisition of reading in the alphasyllabaries. Most of the Indian alphasyllabaries are morphophonemic in nature with suffixes and prefixes carrying substantial syntactic load. Unlike alphabetic scripts where reading errors are predominant at the word level, errors like omission of suffixes and inflections have been reported in languages like Tamil (Aaron, 1982) and Kannada (Nag & Snowling, 2011, Karanth, 2003). In the richly inflected Indian languages, it is therefore essential to plan reading interventions that go beyond supporting skills at the word level.

To conclude, reading research in alphasyllabaries needs to be extended to study the multiple Indian scripts to broaden our understanding of reading mechanisms. Such studies in the alphasyllabaries may explore salient deficit areas like akshara knowledge, syllable and phoneme processing, naming speed, visuo-spatial complexity of the orthography and oral language skills particularly vocabulary and morpho-syntactic knowledge. Longitudinal treatment-based studies might be useful to identify risk factors in children learning to read in alphasyllabaries. Future research may target language impaired children at risk to develop reading impairments, including children with Specific Language Impairment. There is also a pressing need for development and standardization of language and literacy assessment batteries in the alphasyllabaries.

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