

# Dyslexia and Hyperlexia in Bilinguals

R. Malatesha Joshi<sup>1,\*</sup>, Prakash Padakannaya<sup>2</sup> and S. Nishanimath<sup>3</sup>

<sup>1</sup>*Texas A & M University, College Station, TX, USA*

<sup>2</sup>*Department of Psychology, University of Mysore, Mysore, India*

<sup>3</sup>*Samveda Institute and Research Center, Davangere, India*

This study explores the nature of reading difficulties of two bilinguals in Kannada and English, which vary in their orthographic depth and script layout. VN and MS manifest two different types of reading disabilities, dyslexia and hyperlexia, respectively. The performance of VN was below average on Kannada and English tests of phonemic awareness, spelling, and pseudoword naming. Despite his poor decoding skills, the listening comprehension skill both at the word level and at the sentence level of VN was within the normal range. VN, therefore, can be described to have developmental dyslexia. MS, in contrast, showed good decoding ability in both Kannada and English, but his listening and reading comprehension were poor in both languages. MS, therefore, displays a pattern of reading disability akin to that of hyperlexia. The deficits of both VN and MS, although dissimilar from each other, cut across the linguistic boundaries and affect their performance in both Kannada and English. Copyright © 2010 John Wiley & Sons, Ltd.

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## INTRODUCTION

Failure to master the literacy skills of reading and spelling has attracted the attention of the researchers from diverse fields, such as cognitive psychology, neurosciences, linguistics, speech and hearing sciences, and education. Reading problems can be associated with various environmental factors, such as number of books available at home, parental involvement, and

\*Correspondence to: R. Malatesha Joshi, Texas A & M University, College Station, TX, USA.  
E-mail: mjoshi@tamu.edu

teaching methods (Johnston & Watson, 2006). In addition to these factors, the structure of writing system of a language or the orthography of a language is also thought to be a cause of difficulties in acquiring literacy skills. For instance, Seymour (2006), after comparing eight different European orthographies concluded that linguistic differences, especially aspects of syllable structure and variations in orthographic depth, may be crucial in determining the amount of learning necessary for successful progression through each phase. Thus, the establishment of an effective sight vocabulary and decoding skills in children may need about 2 years of reading experience in English as against 1 year in many European languages such as Finish, Spanish, Italian, and Greek.

The potential influence of orthographies on reading is explained by 'Orthographic Depth Hypothesis' (ODH), advanced by Frost, Katz, and Bentin (1987), according to which '...lexical word recognition in shallow orthographies is mediated primarily by phonemic cues generated prelexically by grapheme-to-phoneme translation. In contrast, lexical access for word recognition in a deep orthography relies strongly on orthographic cues, whereas phonology is derived from internal lexicon' (p. 113). Other formulations of this hypothesis are less stringent in labelling the core processes either as 'orthographic' or as 'phonological' according to the depth of the writing system, as phonological processing has also been shown to be involved in word recognition in deep orthographies (Lukatela & Turvey, 1999, p. 1060). ODH, could, therefore, be defined as the degree of correspondence between orthography and the phonology of the written word, which influences the rate and ease with which literacy skills are acquired.

Ziegler, Perry, Jacobs, & Braun (2001) have suggested that the main difference between word recognition in deep orthographies and shallow orthographies relates to the varying sizes of the processing units that are necessary for successful decoding, and the varying need to switch between different 'grain-size' levels. A similar hypothesis that has been proposed is the 'granularity and transparency hypothesis', according to which '... any orthography, where the print-to-sound translation is one-to-one or transparent will not produce a high incidence of phonological dyslexia regardless of the level of translation, i.e. phoneme, syllable, character, etc. This is the transparency dimension, and (2) even when the relationship is opaque and not one-to-one, any orthography whose smallest orthographic unit representing sound is coarse, i.e. a whole character or whole word, will not produce a high incidence of phonological dyslexia. This is the granularity dimension.' (Wydell & Butterworth, 1999, p. 280). (For a detailed explanation of the relationship between orthography and literacy, see Joshi & Aaron, 2006) Caravolas (2006), Seymour (2006), and Landerl and Thaler (2006) have supported the ODH based on their work with monolingual children with diverse linguistic backgrounds. These different theoretical perspectives indicate that the question whether reading disabilities are critically linked to the orthographic structure of a language or are essentially constitutional in origin remains an open issue. Research on reading disabilities in bilinguals or trilinguals may shed light on this question, which is the purpose of this report. We report a case of a bilingual dyslexic and a bilingual hyperlexic who exhibited similar types of errors in two languages despite their orthographic differences.

A pragmatic model that has been used in the identification and intervention of reading problems is the Component Model of Reading (Aaron, Joshi,

Boulware-Gooden, & Bentum, 2008; Aaron, Joshi, & Quatroche, 2008; Aaron, Joshi, & Williams, 1999; Joshi & Aaron, 2000; Catts, Hogan, & Fey, 2003), which is an extension of the 'Simple View of Reading' (Gough & Tunmer, 1986; Hoover & Gough, 1990). According to these models, reading is composed of two basic components: decoding and comprehension. Failure in any one of these components will result in poor reading. Based on this criterion, one would expect three types of reading problems: (a) those with poor decoding but good comprehension skills; (b) those with good decoding but poor comprehension skills; and (c) those with poor decoding as well as comprehension skills. Aaron *et al.* (1999) found about 8% of the students with each of the three kinds of reading problems in a sample of 200 students in grades 3–6. Furthermore, when children with decoding problems were instructed in a programme designed to improve decoding skills and children with comprehension problems were instructed in a programme designed to improve comprehension, there was an improvement in reading compared with a group of children who were not provided with differentiated instruction (Aaron, Joshi, Boulware-Gooden *et al.*, 2008). Individuals with good linguistic comprehension but poor decoding are generally referred to as developmental dyslexics. However, individuals with good decoding but poor linguistic comprehension are referred by different names, such as poor comprehenders (Cain & Oakhill, 1999; Cain, Oakhill, Barnes, & Bryant, 2002; Nation & Norbury, 2005) and hyperlexics (Catts *et al.*, 2003; Newman, Macomber, Babitz, Volkmar, & Grigorenko, 2007; Richman & Kitchell, 1981; Rispens & VanBerckelar, 1991; Snowling & Hulme, 2005). Individuals with both poor decoding and poor comprehension skills are referred to as specific language impaired (Nation & Norbury, 2005) or language-learning disabled (Catts *et al.*, 2003) or garden-variety poor readers (Stanovich, 1988).

Dyslexia, according to the International Dyslexia Association (2002), 'is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction.' This definition of dyslexia as decoding problem accompanied by poor comprehension (both listening and reading) is widely accepted, while the definition of hyperlexia is not very clear-cut. For instance, Silberberg and Silberberg, in their 1967 study, explained the phenomenon of hyperlexia in children with various forms of 'cerebral dysfunction'. However, in their 1971 study, they explained hyperlexia on a continuum of word recognition skills in normal population. Niensted (1968) and Richman and Kitchell (1981) referred to hyperlexia as discrepancy between word recognition and comprehension. As Grigorenko, Klin, and Volkmar (2003), after reviewing the literature on hyperlexia, concluded, 'Both positions are still very much present in today's literature: Some researchers are adamant about hyperlexia being a clinical phenomenon whereas others readily assign the label of hyperlexia to children with word-recognition-comprehension discrepancies irrespective of any clinical diagnosis' (p. 1080). In this study, we have used the term hyperlexia to refer to the discrepancy between word recognition and general comprehension (both listening and reading). That is, dyslexics have poor decoding skills but good linguistic comprehension skills, while hyperlexics have good decoding skills but poor comprehension skills.

Since James Hinshelwood (1895, 1902) and Pringle Morgan (1896) first published the cases of developmental dyslexia, much progress has been made in the area of dyslexia. Compared to dyslexia research, research in hyperlexia should be considered as lagging behind. For instance, an examination of the ISI Web of Science revealed that during the last 10 years (1999–2009), there were 2470 studies published on the topic of dyslexia, while there were only 22 studies published on hyperlexia. As there are more studies on the topic of dyslexia as well as the concept is fairly well accepted, a detailed review of the studies on dyslexia will not be provided here. However, because of the fact that the definition of hyperlexia is not that clear-cut and also there are not many studies on hyperlexia, a brief review is provided below.

Bronner, as early as 1917, described a case of a 13-year-old boy, who had a mental age of 7.4 years who could read fluently a grade 3 passage but was unable to reply to any common-sense questions and could not reproduce with any semblance of correctness a passage read to him. The boy wrote well and his spelling was also fair. Silberberg and Silberberg (1967) used the term hyperlexia to describe word-decoding ability that is out of proportion to comprehension ability. On the basis of their observation of 20 children who 'recognized words on a higher level than their ability to integrate them' (p. 41), Silberberg and Silberberg (1971) concluded that hyperlexia suggests a continuum of word-recognition skills which may exist separate and apart from general verbal functioning. By 1982, sufficient information about hyperlexic children had accumulated which enabled Healy (1982) to raise the question: 'Is there an identifiable syndrome of hyperlexia?' and to answer it in the affirmative (also see Aram & Healy, 1988; Aram, Rose, & Horwitz, 1984). As stated above, some researchers have reported cases of hyperlexia as just a discrepancy between word recognition and general comprehension difficulties, while others, such as Jackson and Coltheart (2001), have used the term hyperlexia strictly to those with general deficit in cognitive and comprehension (p. 158). Nation and Norbury (2005) have suggested separating the terms poor comprehenders and hyperlexia and estimate that approximately 10% of the school age children may be classified showing specific comprehension impairment (also see Cain *et al.*, 2002; Nation & Snowling, 1997). Nation and Norbury further clarified that most children with hyperlexia are autistic or show features of autism and show general impairments in reading comprehension accompanied by poor vocabulary and oral language comprehension although decoding is within the normal range (p. 26). The controversy about the definition of hyperlexia is not settled as even in a recent study, Newman *et al.*, (2007) used the term hyperlexia to refer to children whose decoding ability is out of proportion with reading comprehension. The range of IQ scores of 10 hyperlexic children was from 92–116 in the study by Richman and Kitchell (1981). Kennedy (2003) selected hyperlexic patients based on the discrepancy between decoding and reading comprehension.

One of the reasons for the equivocalness of the term may be, as Silberberg and Silberberg had pointed out, hyperlexia could be viewed as a continuum of word recognition skills. In one of the large-scale studies, that included 30 participants with hyperlexia, Richman and Wood (2002) could identify two different profiles: 19 hyperlexics classified as language disorder hyperlexic and 11 as nonverbal disorder hyperlexics. Many researchers (Kennedy, 2003; Richman & Wood, 2002; Sparks, 2001) classify hyperlexia on basically three criteria: spontaneous word

reading; impaired comprehension on both listening and reading; and word recognition (decoding) skill above expectations. Irrespective of whether hyperlexics, with or without autism spectrum disorder, Nation (1999), after reviewing the literature on hyperlexia, concluded that 'although poor comprehenders show less severe deficits, they are similar to hyperlexic children in terms of the pattern of strengths and weaknesses of their reading skills' (p. 347). In this study, we have used the broader definition of hyperlexia, as good decoding but poor linguistic comprehension.

### **Dyslexia in Bilinguals**

Much of the information about reading problems in bilinguals has come from the studies of adult readers who have lost the ability to read as a result of neurological impairments. As early as 1895, James Hinshelwood, an ophthalmologist from Glasgow, reported the case of a 58-year-old teacher of French and German who suddenly lost his ability to read printed and written materials in both the languages. This description is almost identical to the one provided by Dejerine (1892) 3 years earlier. The few published studies have reported the problems in both the languages. For instance, Critchley (1970) mentions three cases of bilingual dyslexia, two were Arabic–English dyslexics and one Hebrew–English dyslexic. Although the participants made analogous errors in both the languages, the errors in Arabic could be considered more as visual errors than the ones in English. Based on the limited evidence available on bilingual dyslexia up to 1984, Obler (1984) concluded that 'if a child is dyslexic in learning to read one language, then he or she is as a rule dyslexic in learning to read the next' (p. 493). However, there can be exceptions to this generalization. For instance, Wydell and Butterworth (1999) studied a developmental bilingual dyslexic, who was dyslexic only in English but not in Japanese, although he had studied Japanese later as a second language.

Karanth (1992) reports an English–Kannada bilingual, SME, and an English–Hindi–Kannada trilingual, AK. Both children had problems reading and writing in all the languages, and the errors were similar in all the scripts. While reading English, SME, made errors such as reading *fond* for *found*; *does* for 'did' and *fish* for 'fishes' and while writing English words to dictation, he wrote, *laf* for 'laugh', *thes* for 'these', *Disembre* for 'December', and *cok* for 'cock'. In reading Kannada, SME substituted characters that looked similar, like /na/ and /sa/. In English, they were mostly problems of regularization, *mussle* for 'muscle' and *laf* for 'laugh', while on more regular alphasyllabic scripts of Kannada and Hindi, there were both regularization and visual errors. The reading and writing errors of AK in English and Kannada were also similar to those of SME which led Karanth to conclude that '...it appears that it is the irregular feature that contributes to the reading difficulty and the severity of the reading difficulty appears to be linked to the amount of irregularity in the script' (p. 61). Nag-Arulmani (2003) examined two cases of bilinguals. K performed poorly on a phoneme substitution task in both Kannada and English. However, when several tasks consisting of phoneme and syllable manipulation tasks were administered in both Kannada and English to another bilingual dyslexic in Kannada and English, A, the results were similar, suggesting a 'core deficit' in phonological

skills when compared with age-matched controls in both the languages. Gupta (2002) reported a Hindi–English biscriptal dyslexic, JS, whose problem in English was in reading irregular words, while the errors in Hindi were related to reading the *maatras*—the secondary vowels attached to the consonants. Klein and Doctor (2003) studied three cases of biscriptal dyslexics of English and Afrikaans, a shallow orthography, and found that there were problems with phonological processing in both the languages. Their findings led them to the conclusion that bilinguals do not develop special mechanisms for processing print that are different from those employed by monolingual readers as suggested by Caramazza and Brones (1979) and Masterson, Coltheart, and Mears (1985).

### Hyperlexia in Bilinguals

So far, most of the cases reported on hyperlexia are English-speaking monolinguals. However, there is one case of trilingual hyperlexic reported by Lebrun, Van Endert, and Szliwowski (1988). A microcephalic girl, Isabelle, could read in three languages Dutch, French, and English at the age of 10 years. Dutch was her mother tongue and she could speak and read it aloud fluently. French was her second language and her spoken command of it was rather limited but her reading aloud was as fluent as it was in Dutch. She could read English but could not speak it. Her IQ on the Terman-Merrill was 55 at 4 years and 9 months, which put her mental age at 2 years and 8 months. When tested on Stanford-Binet Intelligence Scale at 7 years and 9 months, her mental age was between 4 and 5 years. As Isabelle was hyperactive, Lebrun *et al.* could not determine whether her poor comprehension in spoken and written language was because of lack of ability or because of attentional problems. Nevertheless, Isabelle's comprehension of both spoken and written language was poor in all the three languages although to a different degree. Her comprehension was best in Dutch and worst in English. Sparks and Artzer (2000) observed hyperlexia type syndrome in both English and Spanish in two participants who had studied Spanish for 2 years. Their decoding skills were superior to their comprehension skills in both the languages. Furthermore, not only their reading of words was superior but also their spelling of both regular and irregular words was superior in both the languages.

After reviewing the literature on dyslexia and hyperlexia, Aaron (1994) summarized the characteristics of the two syndromes in the following manner:

| Dyslexia  | Hyperlexia  |
|---|---|
| Poor decoding (inaccurate)                                | Good decoding (accurate)  |
| Listening comprehension better than reading comprehension | Listening comprehension inferior or same as reading comprehension |
| Reading comprehension superior to decoding                | Reading comprehension inferior to decoding                        |
| Spelling, below average                                   | Spelling, above average   |
| Slow and laborious decoding                               | Average to above average speed of decoding                        |

Aaron classified the above dichotomy based on English-speaking monolinguals. One of the questions that arise, then, is do bilinguals from

different orthographic background exhibit different types of reading problems. This is the focus of the present study.

We present here two Kannada–English bilingual cases, a bilingual dyslexic and a bilingual hyperlexic. First, we provide a brief explanation of Kannada orthography.

### **Kannada Orthography**

Kannada is one of the major Dravidian languages of South India. It is the state language of Karnataka and is spoken by about 50 million people. It has a long history of about 1500 years. The earliest documented inscription is from Halmidi inscriptions dated 450 ACE and has a literary tradition of about 1200 years. According to Coulmas (1996), all Brahmi scripts have the following features: symbols for syllabic (initial) vowels: /a/, /i/, /u/, and /e/; consonant symbols have an inherent vowel /a/ in them; other vowels in CV combinations are denoted by diacritical marks; and consonant clusters are represented by ligatures. Kannada has 50 basic letter symbols that are arranged according to the phonetic classes: vowels → diphthongs → consonants: velars → pre-palatals → retroflexes → dentals → bilabials → semivowels/sibilants/laterals and manner of articulation (short–long; unaspirated–aspirated; unvoiced–voiced). Kannada script presents a mixture of syllabic and alphabetic principles, similar to Korean Hangul. There is almost one-to-one graphophonological equivalence expressed in syllable structure, regular signs of vowels being attached to the basic consonant forms. Each of the vowels, in addition to its syllabic (primary) form, has an intrasyllable (secondary) form, which is used in writing a CV syllable, and each syllable form can be analyzed into its consonant and vowel components. A detailed analysis of Kannada orthography can be found in Karanth (2003, 2006) and Prakash and Joshi (1995).

## **METHOD**

### **Participants**

The performance of the two participants, MS, a bilingual hyperlexic, and VN, a bilingual dyslexic, was compared with a group of eight typically achieving participants. Both MS and VN were about 16 years old at the time of testing and the age of comparison group ranged from 10–16. From the comparison group of eight participants, three were 10 years of age, three were 16 years of age, and two were 14 years old. The three 10-year old participants had 5 years of formal instruction in Kannada and 4 years of formal instruction in English, and the two 14-year-old participants had 7 years of formal instruction in Kannada and 4 years of formal instruction in English. Although chronological age is different, the number of years of formal instruction in English is the same for these two groups of participants because of when they were introduced to formal instruction in English. The three 16-year-old participants were of the same chronological age as MS and VN, and had 10 years of formal instruction in Kannada but their formal instruction in English ranged 6–8 years. All the participants were from middle

class families and according to the reports from the school records, none had repeated a grade nor they had any hearing and uncorrected vision problems.

MS's father worked as an electrical engineer and his mother is a homemaker. MS has an older sister who is also an electronic engineer and pursuing a successful career. He has an elder brother who is a software engineer employed in the UK. The parents did not report any complications during and after birth although MS started to speak rather late for his age. He went to school at the age of six where Kannada was the medium of instruction for the first 3 years. English was introduced as a second language when MS was in grade 4. He had severe learning problems in primary and high school levels. Because of his academic difficulties, when he was 15, MS was sent to a special school for children with learning disabilities. According to the parents' report, MS has a paternal uncle with similar learning problems.

VN is the first of the two children. His father is an epigraphist with two PhDs, a Sanskrit scholar and a professor in Temple Architecture. Mother does not work outside of the home but manages a small business at home. VN has a younger sister who has severe eye problem, which cannot be corrected. Parents did not report any pregnancy and birth-related complications. VN had reading difficulty in both English and Kannada and had severe spelling problems in both the languages. Although the schools promoted him to the next grade every year (due to 'no detention policy'), he was unable to read and write and so could not perform well on tests. Finally, the parents were alerted and he was brought to a special school for remedial education when he was 14. All the participants were exposed to at least 5 years of formal instruction in Kannada and 4 years of formal instruction in English.

## Test Instruments

The following instruments were administered to all the participants. Each participant was tested individually in a quiet room and ample trial items were provided to ensure that the participants understood the directions. Each participant was administered all the tests and sufficient break time was provided to insure that the participants were not fatigued. Testing was completed in about 3 days for each participant.

(I) *Mental ability*. This was measured by Raven's Progressive Matrices (RPM) (Raven, 1984). This is a culture-fair test of analogical reasoning and visuo-spatial organization.

(II) *Decoding*. Decoding in English and Kannada was measured by administering various tests ranging from letter and character knowledge in English and Kannada to nonwords and words of various complexities. A brief explanation of the tests is given below.

(a) *Letter/character naming in English and Kannada* (Coltheart, 1981; Karanth, 1984). The upper case and lower case letters of the English alphabet in 16 font were randomly presented on an 81/2 × 11 paper and the participants were asked to name the letters. A random selection of 58 Kannada characters that included the primary vowels, the basic CV patterns, and the truncated CV patterns was presented and the participants were asked to name the characters. This was

administered to make sure that the participants had the knowledge of the letters and characters. The responses were recorded.

(b) *Nonword reading in English and Kannada* (Coltheart, 1981; Karanth, 1984). There were 28 English nonwords and 15 Kannada nonwords and the participants were asked to name them as best as they could, although they are not real words. Their responses were recorded.

(c) *Regular and irregular words in English* (Coltheart, 1981). There were 39 regular words and 39 irregular words matched for frequency and number of syllables. They were printed in lower case in 16 font one below the other and participants were asked to read them as best as they could. The responses were recorded.

(d) *English word reading* (Joshi & Aaron, 2003). As words may not be classified into regular and irregular words, this test organizes words into four categories: regular, exception, unique, and morphophonemic words. The classification was based on the works by Coltheart (1978), Fischer, Shankweiler, and Liberman (1985), and Waters, Seidenberg, and Bruck (1984). There were 14 words in each category for a total of 56 words. The words were printed in lower case in 16 font one below the other and the participants were asked to read the word as best as they could and the readings were taped.

(e) *Kannada word reading* (Padakannaya, 1999a). This test consists of 150 words ranging in complexity from the simple elements of the Kannada syllabary (V and CV followed by CCV and CCCV) through simple words to more complex words including those with irregular features. The words were typed one after another with sufficient space between two consecutive words row-wise. The participants were asked to read the words as quickly and as accurately as they could. The number of words read accurately in 1 min and the total number of words read along with the time taken to read the entire list were also noted.

(III) *Comprehension*. The participants' comprehension was measured at both the listening level and the reading level.

(i) *Listening comprehension*. Listening comprehension was measured at the word level and at passage level.

(a) *Word level—synonym judgment* (Coltheart, 1981; Karanth, 1984). This test required participants to tell whether two words pronounced by the examiner had similar meaning or not. For example, the examiner presented 'grave' and 'tomb' and asked the participant whether they have the same meanings (synonymous) or not. There were 76 pairs in English and 80 pairs in Kannada. The participants' responses were recorded.

(b) *Passages*. Two English passages and two Kannada passages were read to the participants after which the participants were asked to give a brief summary of the passages and then answer five questions about each passage. These passages were selected based on a pilot study conducted earlier to ensure that the participants understood the passages.

(ii) *Reading comprehension*. As earlier research has shown that reading comprehension can be affected by the type of instruments used (Joshi, Williams, & Wood, 1998), reading comprehension was measured in two ways.

(a) *Questions format*. In this format, the participants have to read a passage in English and in Kannada and give a brief summary of the passage and answer five questions about each passage. These passages were selected based on a pilot study conducted earlier to ensure that the participants understood the passages.

(b) *Cloze format*. Several blanks were left in each sentence of a passage in English and Kannada. Participants were asked to read the passage by filling with appropriate words in the blanks. The correct words were not given to the participants and the purpose here is to see whether the context would help dyslexics and hyperlexics in comprehending the passages. The number of correct words supplied in the blanks was computed. These passages were selected based on a pilot study conducted earlier to ensure that the participants understood the passages.

(IV) *Spelling and dictation*. Joshi and Aaron (2003) test was used as a spelling test. Each word was read by the examiner and then used in a sentence and then the word was pronounced again and the participants were asked to write the word only. All the 56 words were administered in one sitting. Twenty words from the Kannada test (Padakannaya, 1999a) were used as a dictation test. (As the sound of the character is the name of the character in Kannada, dictation test is a more appropriate term for Kannada.) The number of correctly written words in English and Kannada was calculated.

(V) *Speed of processing*. The time taken by participants in naming letters/characters and words in English and Kannada were noted.

(a) *Letter/character naming* (Aaron et al., 1999). Forty English letters in random order were printed in 16 font one below the other and the participants were asked to name them as fast and as accurately as possible. The time taken to name all the letters and the number of correct letters reported were recorded. Another 40 Kannada characters consisting of primary vowels (V) and consonants (CV) were presented to the participants and were asked to name them as fast and as accurately as they could. The time taken to name all the characters and the number of correct characters named were recorded.

(b) *Word naming in English and Kannada*. The amount of time taken to name 150 words in Kannada (Padakannaya, 1999a) and 56 words in English (Joshi & Aaron, 2003) was recorded. The words were printed in 16 font one below the other (lower case in English) and the participants were asked to read as quickly and accurately as they could. The time taken to complete the task and the number of correct words read were noted.

(VI) *Phonological awareness tasks: Rhyme detection, syllable reversal and syllable deletion tasks* (Padakannaya, 1999b; Prakash, Rekha, Nigam, & Karanth, 1993). There were 12 items in each of the three categories. In the rhyme detection, participants were asked to name a rhyming word to the target word. The examiner said the word 'cat' and asked the participant to give a word that rhymes with 'cat'. In the syllable reversal task, bi/trisyllable words were given and the participants were asked to repeat the syllable in the reverse order. For example, given the word pencil, participants have to say it as cil pen. In the syllable deletion task, two or three syllable words were presented and the participant was asked to say the word with a specific syllable deleted. For example, given the word 'magnet', the participant has to say 'net' after deleting 'mag'.

(VII) *Phoneme awareness tasks*. This test consisted of three different tasks: phoneme oddity, phoneme deletion, and phoneme reversal (Padakannaya, 1999b; Prakash et al., 1993). In the phoneme oddity task, given three words, the participant has to select the word which does not share the same phoneme with the other two words. In the phoneme deletion task, the examiner would say a

word and the participant has to say the word without a specific phoneme. In the phoneme reversal task, after hearing a word presented by the examiner, the participant has to say the word in the reverse order. There were 12 items each in phoneme oddity and phoneme reversal tasks and 24 items in phoneme deletion task. This test was administered only in English but not in Kannada because of its alphasyllabary nature.

## RESULTS

The raw scores of MS, VN, and mean scores of normally achieving participants with the range, in parentheses, are summarized in Table 1.

(I) *Mental ability.* The scores on RPM for MS and VN were 43 and 50, respectively, and the average score was for normally achieving group was 48, and ranged from 45 to 50. The average score is considered to be 47 and hence, the mental ability of these individuals falls within the normal range.

(II) *Decoding.*

(a) *Letter/character naming in English and Kannada.* As shown in Table 1, all the participants named the letters and characters correctly. The participants were familiar with all the letters of the English alphabet and the basic syllable structure in Kannada. Due to the nature of Kannada orthography, it is possible to have over 500 characters in Kannada. Because of the high number, participants were not tested on all the characters. However, as the Kannada syllable matrix follows a general pattern, one can test the knowledge of the characters with a sample of items.

(b) *Nonword reading in English and Kannada* (Coltheart, 1981; Karanth, 1984). On the nonword reading task in English, MS could name 27 of 28 nonwords, while VN could name 20 on that list. On the Kannada nonwords list, MS could name 15 of 15, while VN could name 9 of 15. Normally achieving group could name all the nonwords in both English and Kannada. Based on their performance, it could be concluded that MS did not have decoding problem in both English and Kannada, while VN had decoding problem in both English and Kannada.

(c) *Regular and irregular words in English* (Coltheart, 1981). On the regular word list, MS read 37 of 39 words. The two errors he made were reading *barg* (the reading and spelling errors committed by the participants are shown in italics) for *barge* and *struven* for *strewn*. VN could read only 32 of 39 words. His misreadings were *county-country*; *check-click*; *shrug-shur*; *barge-braj*; and *spear-spar*. The performance of MS was better than that of VN on this task both quantitatively and qualitatively. The two errors MS made were closer to the target word phonetically, while the errors of VN did not resemble the target word. It appears that VN would get the first few sounds of the word and then guess the rest. On the list of irregular words, MS read 31 of 39 words correctly, while VN read only 17 words correctly. Similar to the performance on the regular word list, the errors committed by MS were mainly regularization errors like reading *lose* as *loss*, while the errors committed by VN, similar to his reading of regular words, were more of random guesses after the initial phoneme as seen by his misreadings: *cough-cot*; *glove-goat*; *subtle-sublet*; *debt-dealt*). Errors of the participants in the comparison group ranged from two to four words and they

Table 1. Performance of MS, VN, and normally achieving children on various tasks

| Tests                          | MS<br>(hyperlexic) | VN<br>(dyslexic) | Normally<br>achieving ( $n = 8$ ) |
|--------------------------------|--------------------|------------------|-----------------------------------|
| <i>Mental ability</i>          |                    |                  |                                   |
| RPM                            | 43                 | 50               | 47 (45–50)                        |
| <i>Letter naming</i>           |                    |                  |                                   |
| English                        | 26/26              | 26/26            | 26/26                             |
| Kannada                        | 58/58              | 58/58            | 58/58                             |
| <i>Nonword reading</i>         |                    |                  |                                   |
| English                        | 27/28              | 20/28            | 28/28                             |
| Kannada                        | 15/15              | 9/15             | 15/15                             |
| <i>Word reading</i>            |                    |                  |                                   |
| English (Coltheart's list)     |                    |                  |                                   |
| Regular words                  | 37/39              | 32/39            | 36/39 (35–37)                     |
| Irregular words                | 31/39              | 17/39            | 37/39 (36–38)                     |
| Joshi & Aaron list             | 51/56              | 42/56            | 54/56 (53–55)                     |
| Kannada                        | 147/150            | 131/150          | 149/150 (147–149)                 |
| <i>Listening comprehension</i> |                    |                  |                                   |
| Word level (synonyms)          |                    |                  |                                   |
| English                        | 51/76              | 62/76            | 76/76                             |
| Kannada                        | 64/80              | 79/80            | 80/80                             |
| Passage comprehension          |                    |                  |                                   |
| English                        | 25%                | 95%              | 100%                              |
| Kannada                        | 25%                | 95%              | 100%                              |
| <i>Reading comprehension</i>   |                    |                  |                                   |
| Passage comprehension          |                    |                  |                                   |
| English                        | 25%                | 70%              | 100%                              |
| Kannada                        | 30%                | 70%              | 100%                              |
| Cloze format                   |                    |                  |                                   |
| English                        | 7/19 (37%)         | 12/19 (63%)      | 19/19 (100%)                      |
| Kannada                        | 4/18 (25%)         | 10/18 (56%)      | 18/18 (100%)                      |
| <i>Spelling</i>                |                    |                  |                                   |
| English                        | 52/56              | 28/56            | 54/56 (53–55)                     |
| Kannada (dictation)            | 17/20              | 7/20             | 20/20                             |
| <i>Speed</i>                   |                    |                  |                                   |
| Letters (40)                   |                    |                  |                                   |
| English                        | 17.30              | 23.22            | 17.85 (16.5–19)                   |
| Kannada                        | 14.99              | 21.22            | 16.16 (14–17)                     |
| Words                          |                    |                  |                                   |
| Kannada (150) (wpm)            | 93–1 = 92          | 37–2 = 35        | 80 (79–81)                        |
| Total time                     | 110 s              | 500 s            | 130 s (125–135)                   |
| Total errors                   | 3                  | 19               | 1–2                               |
| English (56) (wpm)             | 55–4 = 51          | 30–8 = 22        | 53 (average 2 errors)             |
| <i>Phonological awareness</i>  |                    |                  |                                   |
| Rhyme recognition              |                    |                  |                                   |
| English                        | 12/12              | 12/12            | 12/12                             |
| Kannada                        | 12/12              | 12/12            | 12/12                             |
| Syllable deletion              |                    |                  |                                   |
| English                        | 12/12              | 12/12            | 12/12                             |
| Kannada                        | 12/12              | 12/12            | 12/12                             |
| Syllable reversal              |                    |                  |                                   |
| English                        | 12/12              | 10/12            | 12/12                             |
| Kannada                        | 12/12              | 12/12            | 12/12                             |

Table 1. *Continued*

| Tests                     | MS<br>(hyperlexic) | VN<br>(dyslexic) | Normally<br>achieving ( $n = 8$ ) |
|---------------------------|--------------------|------------------|-----------------------------------|
| <i>Phonemic awareness</i> |                    |                  |                                   |
| English                   |                    |                  |                                   |
| Phoneme oddity            | 12/12              | 9/12             | 11/12                             |
| Phoneme deletion          | 24/24              | 12/24            | 24/24                             |
| Phoneme reversal          | 12/12              | 2/12             | 12/12                             |

Table 2. Sample reading errors of MS, VN, and normally achieving group on Joshi and Aaron (2003) list

| MS (hyperlexic)      | VN (dyslexic)            | Normally achieving |
|----------------------|--------------------------|--------------------|
| Bacon– <i>bakaan</i> | Past– <i>post</i>        | Tomb– <i>tomb</i>  |
| Ghost– <i>aghost</i> | Beak– <i>bake</i>        | Sew– <i>sue</i>    |
| Tomb– <i>tomb</i>    | Tomb– <i>mob</i>         |                    |
| Sew– <i>sue</i>      | Wool– <i>owl</i>         |                    |
| Lose– <i>loss</i>    | Thorough– <i>through</i> |                    |

were mostly phonetic errors, and the average scores were 36 and 37 for regular and irregular words, respectively. *Pint* was misread by all.

(d) *English word reading* (Joshi & Aaron, 2003). MS read 51 words correctly of 56 and VN read 42 of 56 on this test. Similar to the performance on the Coltheart's list of regular and irregular words, MS's mistakes were closer to the target word, while VN's errors were not. Some of their errors are summarized in Table 2.

(e) *Kannada word reading* (Padakannaya, 1999a). On the Kannada list consisting of 150 words, MS read 147 words and VN read only 131 words. Although the three errors of MS could be considered as visual confusions, VN's errors consisted of both visual and phonological in nature. The normally achieving group missed only two to three words and the average score was 149.

Based on these results, it could be inferred that MS has good decoding ability in both English and in Kannada, while VN has poor decoding ability in both English and Kannada. There were qualitative and quantitative differences in their performance on the decoding task as well.

### (III) *Comprehension.*

#### (i) *Listening comprehension.*

(a) *Word level—synonym judgment* (Coltheart, 1981; Karanth, 1984). On the English synonym judgment task, MS scored 51 of 76 correct, while VN judged 62 correctly. On the Kannada synonym judgment task, MS judged 64 pairs correctly, while VN judged 79 pairs correctly. The errors of MS were judging mainly nonsynonymous pairs as synonymous, while the few errors of VN were in the opposite direction, that is, judging synonymous pairs as nonsynonymous. The normally achieving group did not commit any errors on this task. The results indicate that word level comprehension by VN was superior to that of MS.

(b) *Passages.* In understanding the passages and answering questions, MS's performance was 25% correct and VN's was 95% correct in both English and Kannada. When asked to summarize the passages, MS's summary did not relate

to the passage and was way off the mark, while VN's summary was related to the passage.

Based on their performance, it could be inferred that the listening comprehension of MS is low, while VN has relatively good listening comprehension even at the word level.

(ii) *Reading comprehension.*

(a) *Questions format.* When participants were asked to read the passage and then answer questions, MS could answer 25 and 30% of the questions correctly in English and Kannada, respectively. VN could answer 70% of the questions correctly in both English and Kannada. The normal group answered all of the questions correctly. Similar to the performance on the listening comprehension measure, when asked to summarize the passage, MS's summary was way off the target despite accurate decoding, while VN's summary approximated the target passage despite very poor decoding.

(b) *Cloze format.* Whether context would facilitate comprehension was assessed by the cloze format. In the English test, MS supplied 7 words correctly of 19 blanks (37%), while VN supplied 12 words (63%) correctly, and in the Kannada test, MS supplied 4 words correctly of 18 blanks (22%), while VN supplied 10 words (56%) correctly. The normally achieving group supplied the correct words for all the blanks in both English and Kannada. Two interesting observations about the performance of both MS and VN on reading comprehension measures were, MS's performance was very poor in both English and Kannada despite being able to decode well, while VN performance was better on comprehension in both the languages than it was on decoding tasks despite his poor decoding skills. Furthermore, the performance of both MS and VN was better on the English task than on the Kannada task, despite the fact that both the participants were exposed to both spoken and written Kannada longer than English. Perhaps, this might be due to the nature of the Kannada Script with over 500 characters used even in simple passages.

Based on their performance on various tasks administered, it could be inferred that MS has poor comprehension despite superior decoding skills in both English and Kannada, whereas VN has good listening comprehension in both the languages. This was true at both the word level and at the passage level. Poor comprehension of MS cannot be attributed to poor memory skills, as his comprehension was low even at the word level, which does not require remembering words for a longer time. Although both the participants performed poorly on reading comprehension, the performance of MS was worse than VN. However, VN's poor performance can be attributed to his poor decoding skills but MS's performance cannot be attributed to poor decoding as he had superior decoding skills. MS's poor comprehension is due to general comprehension deficit and not due to decoding problems.

(IV) *Spelling and dictation.* On the English spelling task, MS wrote 52 words correctly and VN wrote 28 words correctly of 56 total words. Similar to the performance on the word-decoding task, MS's errors were close to the target word and could be considered phonologically analogous, while the errors of VN were random errors and could not be considered as phonologically acceptable. The average score of normally achieving group was 54 correctly spelled words. The spelling errors of the participants in English are summarized in Table 3. In the Kannada dictation task, MS wrote 17 words correctly but VN wrote only 7

Table 3. Sample spelling errors of MS, VN, and the normal group on Joshi and Aaron (2003) list

| MS (Hyperlexic)         | VN (Dyslexic)            | Normally achieving  |
|-------------------------|--------------------------|---------------------|
| Break– <i>brake</i>     | Sign– <i>sing</i>        | Break– <i>brake</i> |
| Thief– <i>theif</i>     | Thief– <i>Thife</i>      | Sew– <i>sow</i>     |
| Hygiene– <i>hygeine</i> | Hygiene– <i>Higeen</i>   |                     |
| Death– <i>deadth</i>    | Thorough– <i>thought</i> |                     |
|                         | Wool– <i>woon</i>        |                     |
|                         | Socks– <i>seack</i>      |                     |
|                         | Soup– <i>spupe</i>       |                     |

words correctly and the normal comparison group wrote all the 20 words correctly. Again, MS’s errors were close to the target words and the three errors were at the secondary vowel level, while VN’s errors, similar to his errors in spelling English words, were random errors and could not be considered as phonologically acceptable. Based on the spelling and dictation tasks, MS’s performance was better than VN. This could be attributed to the superior decoding ability of MS.

(V) *Speed of processing.*

(a) *Letter/character naming.* MS took 17.30 and 14.99 s and VN took 23.22 and 21.22 s to name the 40 English letters and 40 Kannada characters, respectively. The normally achieving group took on the average 17.85 and 16.16 s to complete the same tasks in English and Kannada, respectively.

(b) *Word naming in English and Kannada.* In 1 min, MS read 93 words in Kannada and made 1 error, while VN read 37 words with 2 errors and the normally achieving group read 80 words with no errors. For the entire list of 150 words, MS took 110 s and made 3 errors; VN took 500 s with 19 errors and the normal group took 130 s with 2 errors. In the Joshi–Aaron test, MS read 55 words with 4 errors and VN read only 30 words with 8 errors in 1 min. The normal group also read on the average of 53 words in 1 min and the range of errors was 1–2.

Based on their performance, MS had adequate speed of processing, while VN’s speed of processing was slower than MS’s.

(VI) *Phonological awareness tasks.* In the rhyme recognition, syllable deletion, and syllable reversal tasks in English and Kannada, all the three groups of participants reached the ceiling except VN on syllable reversal task, in which he missed 2 of 12 items.

This result leads to the conclusion that the poor performance on decoding, comprehension, and speed of processing of the participants cannot be due to syllable awareness problems.

(VII) *Phoneme awareness tasks.* On the phoneme oddity, phoneme deletion, and phoneme reversal tasks, MS reached the ceiling; VN scored 9/12, 12/24, and 2/12, respectively, on the three phoneme awareness tasks. Based on these results, it appears that the decoding problem of VN was at the phoneme level in English and not at the syllable level. Note that this task was administered only in English but not in Kannada because of the difficulty in constructing the items at the phoneme level in Kannada.

## SUMMARY

The performance of MS follows the hyperlexia profile in *both* English and Kannada. His decoding ability, as assessed through speed and accuracy measures of word reading and nonword reading as well as spelling and dictation tasks, was above average compared with his listening and reading comprehension measures. MS's dissociation between decoding and comprehension could be seen in his performance on a spelling task. When asked to write all the words related to the word 'Face', MS wrote the following words in approximately 2 min: *tongue, appear, nourished, community, child, logic, direct, brain, skull, graduate, eucalyptus, tamarind, rotten, zoology, botney, astrology, throat, widow, pupil, and orthodox*. As can be seen, only two words are misspelled but it is hard to find a connection between face and many of the words. Most of the students in his class wrote parts of the face such as eye, ear, etc., and some adjectives, such as happy, cheerful, blush, etc.

The performance of VN, on the contrary, follows the dyslexia profile in *both* English and Kannada. His decoding ability was below average compared with his listening comprehension and reading comprehension scores. The problem with his reading comprehension was due to his decoding problems and not due to comprehension deficit *per se*. Furthermore, the decoding problem seemed to be at the phonemic level in English and not at the syllable level.

## CONCLUSION

On the basis of above observations, it could be concluded that similar reading problems appear both in English and Kannada despite their orthographic differences. Gupta (2004) also found similar results among a group of 30 Hindi-English, bilingual dyslexics. Her study found that errors of reading in both English and Hindi shared about 70% of the letters of the intended stimulus. For example, the errors in English were reading 'then' as *thin*; 'felt' as *flat*, and 'cliff' as *chief*, while Hindi errors included 'kalam' (meaning pen) read as *kamal* (meaning lotus) and 'chitra' (picture) read as *mitra* (friend). The orthography-phonology relationship may not, therefore, in itself be the causative factor of reading problems, although it could very well exacerbate a preexisting cognitive problem. Although there may be a core phonological deficit in dyslexics, the consequences of this deficit may be far greater in English than in Shallow orthographies such as Kannada and other regular alphabetic and alphasyllabic orthographies as well. For instance, children learning to read German, a relatively shallow orthography, manifest little decoding difficulties but, are, nevertheless slow readers (Landerl, Wimmer, & Frith, 1997; Seymour, 2006). As suggested by Psycholinguistic Grain Size theory (Ziegler & Goswami, 2005), differences in strategy during the reading acquisition process arise from the size of the speech unit represented by each written unit in a script. Furthermore, as Feitelson (1996) noted as early as 1966 that when two languages, even if they have different origins or orthographies, share similar characteristics, then the learning problems will be similar. Similarly, similar strategies may be used to decode in two orthographies if the orthographies are closely related. Thus, majority of the bilingual studies have examined two orthographies that are

similar and the findings have been that bilinguals had problem in both the languages. However, one exception is the Japanese–English bilingual (Wydell & Butterworth, 1999), where the subject had reading problems only in English but not in Japanese. This may be because English uses an alphabetic script and Japanese uses a combination of syllabic script in Kana and a logographic script in Kanji and they are farther apart in their orthographic relationship compared with, for instance, English and Spanish. Thus, among bilinguals with reading problems, whether they exhibit reading problems in one or both the languages may depend on the ‘orthographic distance’ of the two languages. If the two orthographies are similar, such as Spanish and Italian, then reading problems might occur in both the languages. On the contrary, if two orthographies are farther apart, such as English and Japanese, it is possible to exhibit reading problem in only one orthography, as demonstrated in Wydell and Butterworth study of Japanese–English bilingual.

In addition to examining dyslexia in different orthographies of various depths or psycholinguistic grain size, much more research is needed on both monolingual and bilingual hyperlexia, as hyperlexics, depending on which definition is used, may make up almost 10% of the school children. Finally, considering the fact that the majority of world’s population is bilingual, more research on reading disability in bilingual population with varying orthographic distances is needed.

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