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Dyslexia: Symbol processing difficulty in the Kannada language

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ABSTRACT: The purpose of this study was to investigate whether among children who speak Kannada, a Dravidian language from South India, there are those who show the same pattern of specific dyslexia as has been found to occur in children who speak European languages. The performances of 14 dyslexic children, aged between 8 and 10 years, whose native language was Kannada, were compared on a variety of tasks with fourteen normal readers and fourteen non-dyslexic poor readers. There were no significant differences between the three groups on tests of visual discrimination, visual recognition, visual recall, memory for shapes in sequence, or auditory discrimination. There were differences, however, between the dyslexics and the normal readers on tests of recall of auditorily presented digits, word analysis, word synthesis, and on two tests of visual-verbal association. The non-dyslexic poor readers were more similar to the dyslexics on recall of auditorily presented digits and word synthesis but more similar to the normal readers on word analysis and on the two tests of visual-verbal association. It is argued that these results are evidence of a consistent pattern in specific dyslexia which does not depend on any one writing system or geographical location.

KEY WORDS: Dyslexia, Phoneme-grapheme correspondence, Symbolic processes, Verbal deficit hypothesis, Visual-verbal association, Word analysis, Word synthesis

This paper is concerned with 'specific developmental dyslexia', the phenomena described by Hinshelwood (1917), Orton (1937), Hallgren (1950), Critchley (1970), Naidoo (1972), Miles (1983), Aaron (1987), Miles & Miles (1990), Thomson (1990) and many others. Dyslexia in this sense is not simply 'poor reading'; what is implied is a *syndrome*, that is, a group of symptoms each of which may be non-significant on its own but which taken together form a meaningful pattern. There is now good evidence that these difficulties are constitutional in origin (Galaburda et al. 1987) and that they are indicative of problems at the phonological level (Vellutino 1979, 1987; Catts 1989). More specifically, they are the result of 'an inability to represent and access the sound of a word in order to help remember the word' (Vellutino 1987: 20). In the following discussion, this problem will be described as one of 'verbal labeling'.

Defined in this way, the term 'developmental dyslexia' has the following implication: (1) the phenomena in question are likely to be found in many different parts of the world and are independent of any particular writing

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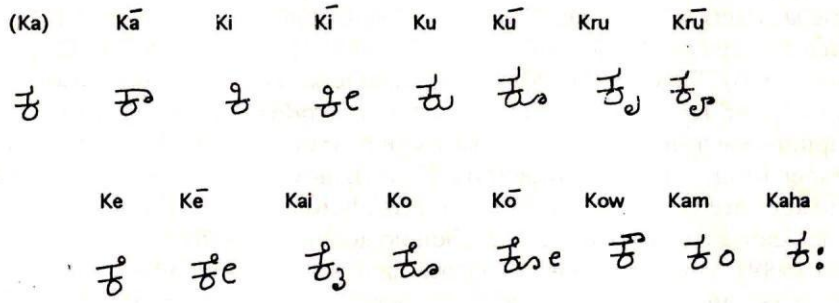
system, (2) dyslexics differ from normal readers only in tasks which involve verbal labeling, and (3) in the case of tasks which involve verbal labeling they also differ from non-dyslexic poor readers, that is, those whose weakness at reading has arisen from other causes such as lack of opportunity or lack of suitable teaching.

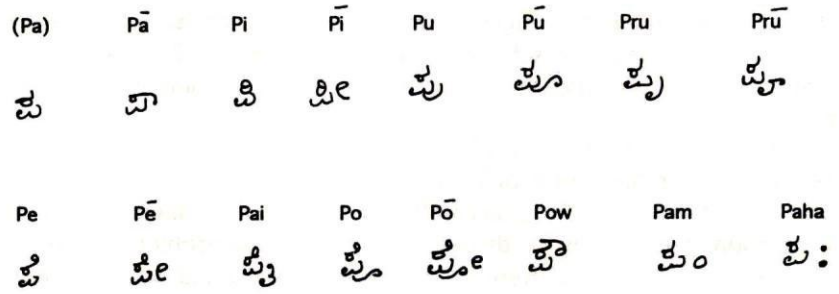
The research reported in this paper was designed to test all three of these hypotheses. In the first place, because the experiments were carried out on children in the neighbourhood of Mysore, India, where the spoken language is Kannada, it was possible to test whether generalizations based on experiments with English-speaking children held up in a quite different language. Secondly, because some of the tasks given to the subjects called for verbal labeling and some did not, it was possible to check whether differences between dyslexics and normal readers would be found only when verbal labeling was involved. Thirdly there was the possibility of investigating whether difficulties in verbal labeling would occur only among dyslexics or whether they would be found among non-dyslexic poor readers also.

The script of the Kannada language differs from that of English in many respects. In English the relationship between letters and their spoken equivalents is far from consistent, whereas in Kannada each character stands for a distinct sound. In English there are 26 letters in the alphabet, whereas in Kannada there are 50, of which 16 represent vowel sounds and the remaining 34 represent consonant sounds. Some of the letters in the English alphabet consist partly or wholly of straight lines whereas all the letters in the Kannada alphabet are curvilinear in shape.

In addition to the 50 letters of the alphabet there is another set of symbols, which is collectively called 'Kagunitha'. Each symbol of Kagunitha represents a particular combination of consonant and a vowel. Thus the consonant Ka has the following 15 derivative sounds and symbols:



Similarly the consonant Pa has the following 15 derivative sounds and symbols:



It will be seen that in both cases the consonants combine with vowels in accordance with a definite pattern. The same is true of all the other consonants: the modifications to the initial letter are the same in each case.

As there are 34 consonants and each has 15 derivatives there are altogether 34 × 15 (510) additional symbols in the Kagunitha. Thus the initial learner of the script of the Kannada language is confronted with the task of mastering 50 letters of the alphabet and 510 letters of the Kagunitha. As he proceeds further, he has to learn another set of symbols which represent different combinations of consonants and vowels. Added to this complexity in terms of number of symbols to be learned there is a considerable amount of similarity between the letters: some of them resemble each other in their visual features, some of them in their auditory features, and some of them in both. There is, however, a high degree of regularity in grapheme-phoneme correspondence. Further details of the Kannada script can be found in Ramaa (1985), Ramaa & Lalithamma (1987), and Prakash & Joshi (1989). (For accounts of reading difficulties in different orthographic systems see Aaron & Joshi 1989, and for an account of a case of acquired dyslexia in a Kannada-English bilingual see Karanth 1981, 1985).

A consequence of these complexities is that successful reading and writing in Kannada calls for many different skills. In particular the learner needs to be able to make fine auditory and visual discriminations, to learn visual-verbal associations, and to recall symbolic material both in the visual and in the auditory modality. It was with these requirements in mind that the tests described in the next section were chosen.

Procedure

The logic of the investigation required that three groups of subjects be distinguished, viz. normal readers, dyslexic poor readers, and non-dyslexic poor readers.

In the first place, however, in order to achieve sufficient homogeneity between subjects to allow for comparison, it was necessary to specify a set of what may be called 'basic exclusionary criteria'. These were as follows:

(1) All children had to be aged 8 or over. This meant that all of them had had at least two years of schooling. If children below this age had been selected, it would have been difficult to distinguish genuinely poor readers from 'late starters'.

(2) All had to be free, according to the judgment of their teachers, from gross emotional or behavior problems.

(3) All had to be free from any difficulty in symbol tracking and hand-eye co-ordination. The reason for this stipulation was that problems in this area would have affected the children's performance in ways that would have been irrelevant to the present study. They were therefore required to carry out a sentence copying test, and those unable to do so were excluded from the study.

(4) No children were included unless they had been attending school regularly.

(5) All of them were given an Academic Achievement Motivation Inventory (Ramaa 1985). This precaution was taken so as to ensure that any problems over reading were not due primarily to lack of adequate motivation to learn academic subjects.

(6) All of them had to have normal auditory reception and comprehension. To test auditory reception the appropriate sub-test of the ITPA (Kirk, McCarthy & Kirk 1968) was adapted for use with Kannada-speaking children (Ramaa 1985). For testing auditory comprehension, a special test was devised (Ramaa 1985). It consisted of 8 passages, presented orally to Primary School children in grades I through IV for whom Kannada was the medium of instruction. The children responded orally, and the number of correctly answered questions was taken to be a measure of the child's auditory comprehension.

(7) All of them had to obtain a score above the 10th percentile on the Raven Coloured Matrices (Raven 1962). The purpose of giving this test was not to determine the children's 'IQ' in the traditional sense (a notion that has recently been severely criticized in connection with selecting dyslexics; see Stanovich 1991), but simply to provide a further safeguard, additional to that already secured by the test of auditory comprehension, to prevent any child being included who was significantly mentally handicapped.

A decision then had to be made as to what would be the most suitable test or tests for determining the children's reading level. The following points seemed relevant: first, there is good evidence that it is the decoding aspects of reading which presents dyslexics with their distinctive problems and that their ability to 'process for meaning' is largely unaffected (see, for instance, Ellis & Miles 1981). Secondly, there is evidence that dyslexics are slow at the reading of single letters (Stanley & Hall 1973) and single words (Baddeley at al. 1982). For these reasons the best choice appeared to be a test of single word reading which measures speed of reading. A test that meets these criteria is available in the Kannada language, viz. The Kannada Oral Reading Test (Jaya Bai 1958). This test includes 150 single Kannada words which

represent almost all the distinct features of the Kannada script. It measures word recognition in respect both of speed and accuracy. Norms are available for different grades in the form of the number of words that are correctly read per minute.

Tests of reading comprehension were not considered necessary since the initial selection procedure had already ensured that only children who were normal at auditory comprehension were included. It was also decided in view of the phonic regularity of the Kannada language that a test of non-word reading would not be of much value.

Testing was carried out in 11 schools, both state and private, within the vicinity of Mysore, In all, 550 children were investigated, of whom 246 were judged by their teachers as poor readers and the remaining 304 as normal readers.

In picking out dyslexics and differentiating them from non-dyslexic poor readers it was necessary to take detailed account of what reading skills are the norm at grade I level in the Kannada language. Children at this level are expected to be able to master all the leters of the alphabet and the symbols of the Kagunitha. They are also required to identity simple and high-frequency words, that is, words containing standard combinations of letters which can easily be synthesized, along with words which are identifiable because of their familiarity. When they move on to higher grades they are expected to read words which demand more and more decoding skills and sound-blending ability; and in comparison with European languages there is relatively little dependence on sight vocabulary and contextual clues. If a child reads fewer than 10 words per minute — less than the norm specified for grade I children — it follows that he must be lacking in the basic decoding and blending skills. A child who scores at this level will be at least 2 grades (24 months) retarded if he is in grade III and at least 3 grades (36 months) retarded if he is in grade IV. This degree of retardation was specified as a necessary condition for inclusion in the 'dyslexic' group.

A further necessary condition for inclusion was that, at least since the beginning of the previous academic year, the child should have been receiving extra coaching or academic help at home. This stipulation was made so as to ensure that his poor reading could not have been due simply to lack of opportunity to learn.

It was also decided that the study would be greatly strengthened if it was possible to pick out an additional group (non-dyslexic poor readers) comprising those who, although relatively poor readers, nevertheless possessed the basic skills that are the norm for grade 1. The specified requirement for membership of this group was that their reading score should lie between grade $1\frac{1}{2}$ and grade $2\frac{1}{2}$. This corresponded to between $1\frac{1}{2}$ and $\frac{1}{2}$ grades of retardation (18 to 6 months) if they were in grade III and between $2\frac{1}{2}$ and $1\frac{1}{2}$ grades of retardation (30 to 18 months) if they were in grade IV. It was also stipulated that a child could count as a non-dyslexic poor reader whether or not he had been receiving help at home: provided he possessed

the basic skills which are needed for a pass at grade I it was considered irrelevant how he came by these skills.

It should be emphasized that the difference between the dyslexic and the non-dyslexic poor reader was not simply one of degree of retardation. The intention was to draw a distinction between those who possessed, and those who did not possess, a minimum amount of ability in the areas of decoding and blending.

It is, of course, widely agreed that there are children who show other signs of dyslexia but whose reading problems are only mild (Naidoo 1972; Miles 1983); and it is therefore not impossible in the present investigation that a small number of genuine dyslexics may have been misclassified as 'non-dyslexic poor readers'. Since, however, the differences between the three groups on the relevant tests were all in the expected direction (see section 3) and since, using the same data base, Ramaa & Lalithamma (1987) found further differences between the groups, it seems unlikely that the misclassifications were on any large scale.

When the above criteria were applied, along with the basic exclusionary criteria, 14 of the 246 poor readers came out as dyslexic. 43 children were found to be eligible as 'non-dyslexic poor readers'; and, of these, 14 were selected for inclusion in the present study. This was done in such a way as to provide the best possible match with the dyslexics in respect of age, sex, school grade, type of school, score on the auditory reception test and grade on the Raven Coloured Matrices.

A 'normal reader' was defined as one whose score on the Kannada Oral Reading Test was at or above the expected level. When this criterion was applied, along with the basic exclusionary criteria, 76 children were found to be eligible. 14 of them were selected, again on the principle of 'best possible match'. Details of the three groups are given in Table 1.

Table 1. Description of the 3 groups of children selected for study

	Dyslexics	Non-dyslexic poor readers	Normal readers
Number of boys	7	7	7
Number of girls	7	7	7
Number in school grade III	5	5	5
Number in school grade IV	9	9	9
Mean age in years and months	9.4	9.2	9.4
Mean score on auditory comprehension test	17.2	17.0	17.5
Breakdown of subjects according to grade on Raven Coloured Matrices			
Grade II	0	0	1
Grade III	8	10	10
Grade IV	6	4	3

The 10 tests on which the 3 groups were compared were as follows:

(1) *Visual discrimination.* This test was developed by Devaki (1978). It involves the use of cards containing 4, 5 or 6 items, of which 2, and only 2, are the same shape. The test was administered individually, the child being required to point to the two items which were of the same shape. Thirty cards were used in all, each correct 'pairing' being awarded a single point. The maximum possible score on this test was therefore 30.

(2) *Visual recognition.* This test was based on the 'retentivity' test of Cattell (1953). A card with 10 shapes, none of them easily nameable by children of this age, was presented to the child for one minute. Immediately afterwards another card, having the same visual patterns randomly mixed up with 10 more visual patterns acting as distractors, was presented, the child being asked to point out the previously observed visual patterns. The results were scored by subtracting the number of 'wrong' responses from the number of 'correct' responses. The maximum possible score was therefore 10; negative scores was counted as zero.

(3) *Visual recall.* This test was developed by Ramaa (1985). Initially a number of pairs of meaningless shapes/figures were exposed to a group of primary school children to find out whether they could be copied easily by them. From these, 16 pairs were selected and arranged in 5 sets (3 pairs each in the first four sets and 4 pairs in the fifth set), the complexity (and hence the presumed difficulty) of the sets being gradually increased.

Each card was exposed to the child for about 45 seconds and then covered. The first member of each pair, written on a separate card, was then shown, the child being asked to copy the shape and write its counterpart. There was no time limit. For the first four sets the order of presentation of cards for recall was 2, 1, 3, and for the last set it was 2, 1, 3, 4. This was done to minimize the influence of possible ability to remember sequences. One point was given for each correct response and half a point in the case of near-misses. Since there were 16 pairs the maximum possible score was 32.

(4) *Recall of visual shapes in sequence.* This test is taken from the Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk, McCarthy & Kirk 1968), where it is referred to as a test of 'visual sequential memory'. In contrast, the ITPA test of 'auditory sequential memory' involves recall of digits — a task for which verbal labeling is essential. It is therefore misleading to use terminology which implies that both tests are measures of something called 'sequential memory' and differ only in the modality of presentation.

(5) *Auditory discrimination.* This test was devised by Kumada Valli (1973) and re-standardized by Devaki (1978). It contains 17 pairs of words, one member of the pair being auditorily confusable with the other, for example *ippattu* (= 'twenty') and *eppattu* (= 'seventy'). For each confusable pair of words, a—b, 4 'picture pairs' were drawn and pasted on a sheet of thick paper, viz. a—a, a—b, b—b, b—a.

At the start the children were shown all the pictures and asked to name them orally so that they became familiar with the words to be used. If a child

did not name the picture the experimenter gave its name and, if necessary, explained any possible uncertainties. Practice was given so as to ensure that the children understood what was required, and during the test itself the children were reminded, if this was necessary, to pay attention and listen carefully.

The pairs of names, viz. a—a, a—b, b—b, and b—a, were presented randomly, the child being asked to point to the correct member of the 'picture pair'. Each correct response was scored as 1 point, the maximum possible score being 17.

(6) *Recall of auditorily presented digits.* This was the 'auditory sequential memory' test of the ITPA (Kirk, McCarthy & Kirk 1968). It assesses the child's ability to reproduce from memory sequences of digits increasing in length from 2 to 8. The digits are presented at the rate 2 per second. The child is allowed a second trial at each sequence length if he fails on the first trial but is given extra credit if he succeeds, 2 points being awarded for passing on the first trial and 1 point for passing on the second. A child who passes all the first trials of the 5-digit items would obtain a score of 28.

(7) *Word analysis.* This test was developed by Ramaa (1985). The 33 words which were eventually used were chosen from an initial 'pool' of 42 words after it had been found that correct responses had been given by between 20 and 80 per cent of the children originally tested. The examiner presented words auditorily one at a time to the child who was then asked to analyze the word into its component sounds. If he failed to respond correctly or was silent the examiner passed to the next word. One point was given for each word correctly analyzed, the maximum possible score therefore being 33.

(8) *Word synthesis.* This test was developed by Ramaa (1985). The 24 words which were eventually used in this test were chosen from an initial 'pool' of 30 words after it had been found that correct responses had been given by between 20 to 80 percent of the children originally tested. Components of words were read out by the examiner at the rate of 1 per second with a distinct pause between sounds; the child was then asked to verbalize the whole word correctly synthesized, the maximum possible score therefore being 24.

(9) and (10) *Visual-verbal association tests I and II.* These tests were developed by Ramaa (1985). In brief, what was involved was the selection of a number of 'strokes' often used in the writing systems of various Indian languages. These strokes were combined to form shapes which were unlike any letters known to the children. Each shape, on a random basis, was then given a letter sound of the Kannada alphabet. In test I cards were prepared with combinations of these shapes to form 2-, 3- and 4-letter words. The experimenter indicated to the child what sound was to be attached to each shape, and, after a period of learning, the child had to give the correct sound when the shape formed part of a word. The maximum possible score was 30. Test II was similar except that the cards each contained a single shape and,

after a period of learning, the child had to give the correct sound with no 'word context' to help. The maximum possible score was 20. These 10 tests were given to the 14 dyslexics, the 14 non-dyslexics poor readers, and the 14 normal readers.

RESULTS AND DISCUSSION

Table 2 gives the mean scores (with standard deviation in brackets) for each of the 3 groups on each of the 10 test-items. F-ratios and confidence levels are given below each set of means.

When the F-value was found to be significant at a confidence level of at least $p < 0.05$, t-tests were carried out so as to make possible comparisons between each pair of means. The resultant values of t are set out in Table 3.

In sum, there were no differences between the three groups on visual discrimination, visual recognition, visual recall, memory for shapes in sequence, and auditory discrimination.

The dyslexics differed from the normal readers on memory for digits, word analysis, word synthesis, visual-verbal association I, and visual-verbal association II. On memory for digits and word synthesis the non-dyslexic poor readers were more similar to the dyslexics than to the normal readers; on word analysis, visual-verbal association I, and visual-verbal association II they were more similar to the normal readers than to the dyslexics.

Two of the inital hypotheses were therefore supported. Children who displayed the typical signs of dyslexia — in particular a weakness at tasks which involved verbal labeling — were undoubtedly found among those who spoke the Kannada language and used its distinctive writing system. Secondly, these differences were found only in tasks which involved verbal labeling; on all other tasks the three groups performed at the same level. The further hypothesis, however, viz. that on the five tests which involved verbal labeling the non-dyslexic poor readers would perform like the normal readers and not like the dyslexics, was only partially supported. It held up in the case of word analysis and the two tests of visual-verbal association but not in the case of memory for auditorily presented digits or word synthesis. In the case of memory for auditorily presented digits the results were in the expected direction (the mean score being 18.07 for the non-dyslexic poor readers compared with 15.78 for the dyslexics) but the difference does not reach an acceptable level of statistical significance; in the case of word synthesis the difference was minimal (the mean score being 15.28 and 14.86). It is possible that these two results are due simply to the presence of a small number of dyslexics among the 'non-dyslexic poor readers'. An alternative possiblity, however, is that difficulty with the recall and re-ordering of symbolic material is not limited to dyslexics but is a handicap to most children who are retarded at reading.

Table 2. Means and standard deviations for the scores of the 3 groups on the 10 different tasks

	Visual discrimination	*Visual recognition*	*Visual recall*	*Recall of shapes in sequence*	*Auditory discrimination*
Dyslexics	28.85 (±7.18)	4.36 (±2.31)	5.32 (±3.42)	19.64 (±3.92)	63.00 (±3.64)
Non-dyslexic poor readers	29.07 (±1.07)	3.07 (±2.41)	6.28 (±2.80)	20.42 (±8.84)	63.93 (±2.65)
Normal readers	28.85 (±1.17)	3.28 (±1.99)	5.71 (±1.84)	19.35 (±4.48)	65.43 (±4.64)
F	0.18 (ns)	1.08 (ns)	0.46 (ns)	0.22 (ns)	1.84 (ns)
	Recall of auditorily presented digits	*Word analysis*	*Word synthesis*	*Visual-verbal Association I*	*Visual-verbal Association II*
Dyslexics	15.78 (±1.48)	21.35 (±6.78)	14.86 (±3.24)	16.71 (±3.65)	6.70 (±2.65)
Non-dyslexic poor readers	18.07 (±2.35)	27.00 (±4.15)	15.28 (±3.33)	19.57 (±4.39)	11.23 (±2.75)
Normal readers	21.64 (±5.27)	29.64 (±3.22)	18.07 (±3.41)	19.92 (±4.23)	10.08 (±1.59)
F	9.67^{+}	10.09**	16.72**	4.2^{+}	12.75**

N = 14 for each group; ** $p < 0.01$; $^{+}$ $p < 0.05$; (ns) = not significant.

Table 3. t-values and confidence levels when the groups are compared in pairs

	Dylexics and normal readers	Dyslexics and non-dyslexic poor readers	Normal readers and non-dyslexic poor readers
Recall of auditorily presented digits	3.68**	1.44 (ns)	2.24^{+}
Word analysis	3.67**	2.50*	1.68 (ns)
Word synthesis	4.12***	0.54 (ns)	3.58**
Visual-verbal association I	3.21**	2.86**	0.35 (ns)
Visual-verbal association II	2.87**	3.97***	1.01 (ns)

*** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.02$; $^{+}$ = $p < 0.05$; (ns) = not significant.

CONCLUSION

It has sometimes been suggested that dyslexics can be subdivided according to whether they display 'visual' weaknesses or 'auditory' weakness (Johnson & Myklebust 1967), or whether they are 'dyseidetic' or 'dysphonetic' (Boder 1973). The present results are hard to square with this proposed classification. If 'visual weakness' were a relevant factor, one would have expected differences at visual discrimination, visual recognition, visual recall, and memory for visually presented shapes in sequence; similarly if 'auditory weakness' were a relevant factor one would have expected weakness at the auditory discrimination test. The present results therefore bear out the criticisms which have been leveled at this form of sub-typing, for example by Liberman (1985), by E. Miles (1981, 1991), and by Ramaa & Lalithamma (1987).

Nor is it appropriate to say, without qualification, that dyslexics have 'poor short-term memory'. The results of tasks (6) to (10) do, indeed, confirm that their memory is poor when easily nameable material has to be recalled or ordered; but from the results of task (2) it seems reasonable to infer that their memory for meaningless shapes is no different from that of anyone else — a conclusion which is also supported by the findings of Liberman et al. (1982) and those of Done & Miles (1978).

Finally, the results demonstrate conclusively that specific dyslexia is not unique to English or other European languages. Although the orthography of the Kannada language is quite different from that of English it was still possible to identify dyslexics among Kannada learners and to show that the same functional deficits were present as those found among dyslexics in other parts of the world.

REFERENCES

Aaron, P. G. (1987). Developmental dyslexia: Is it different from other forms of reading disabilities?, *Annals of Dyslexia* 37: 109—125.

Aaron, P. G. and Joshi, R. M., eds. (1989). *Reading and writing disorders in different orthographic systems*. Boston: Kluwer.

Baddeley, A. D., Ellis, N. C., Miles, T. R. and Lewis, V. (1982). Developmental and acquired dyslexia: A comparison, *Cognition* 11: 185—199.

Boder, E. (1973). Developmental dyslexia: a diagnostic approach based on three atypical reading-spelling patterns, *Developmental Medicine and Child Neurology* 15: 663—687.

Catell, R. B. (1953). *A guide to mental testing*. London: University of London Press.

Catts, H. W. (1989). Phonological processing deficits and reading disabilities, in: A. G. Kamhi and H. W. Catts (eds.), *Reading disabilities: A developmental language perspective*. Boston: Little, Brown.

Critchley, M. (1970). *The dyslexic child*. London: Heinemann.

Devaki, D. (1978). A reading readliness test in Kannada: Its development and standardization. Unpublished dissertation, University of Mysore.

Done, D. J. and Miles, T. R. (1978). Learning, memory, and dyslexia, in: M. M. Gruneberg, P. E. Morris and R. N. Sykes (eds.), *Practical aspects of memory*. London: Academic Press.

Ellis, N. C. and Miles, T. R. (1981). A lexical encoding deficiency I, in: G. Th. Pavlidis and T. R. Miles (eds.), *Dyslexia research and its applications to education*. Chichester: Wiley.

Galuburda, A. M., Corsiglia, J., Rosen, G. D. and Sherman, G. F. (1987). Planum temporale asymmetry: Reappraisal since Geschwind and Levitsky, *Neuropsychologia* 25: 853—868.

Hallgren, B. (1950). Specific dyslexia (congenital word blindness): A clinical and genetic study, *Acta Psychiatrica et Neurologica*, Supplementum 65, i—xi and 1—287.

Hinshelwood, J. (1917). *Congenital word blindness*. London: H. K. Lewis.

Jaya Bai, K. (1958). Standardization of Kannada oral reading test for primary school. Unpublished dissertation, University of Mysore.

Johnson, D. J. and Myklebust, H. R. (1967). *Learning disabilities: Educational principles and practices*. New York/London: Grune & Stratton.

Karanth, P. (1981). Pure alexia in a Kannada-English bilingual, *Cortex* 17: 187—198.

Karanth, P. (1985). Dyslexia in a Dravidian language, in: K. E. Patterson, J. C. Marshall, and M. Coltheart, *Surface dyslexia*. London: Lawrence Erlbaum Associates.

Kirk, S. A., McCarthy, J. J. and Kirk, W. D. (1968). *Illinois test of psycholinguistic abilities* (rev. ed.). University of Illinois.

Kumada Valli, S. (1973). Relationship between articulation and discrimination of Kannada speech sounds in terms of distinctive features. Unpublished Dissertation, University of Mysore.

Liberman, I. Y. (1985). Should so-called modality preferences determine the nature of instruction for children with reading disabilities?, in: F. H. Duffy and N. Geschwind (eds.), *Dyslexia: A neuroscientific approach to clinical evaluation*. Boston: Little, Brown.

Liberman, I. Y., Mann, V. A., Shankweiler, D. and Werfelman, M. (1982). Children's memory for recurring linguistic and non-linguistic material, *Cortex* 18: 367—375.

Miles, E. (1981). A study of dyslexic weaknesses and the consequences for teaching, in: G. Th. Pavlidis and T. R. Miles (eds.), *Dyslexia research and its applications to education*. Chichester: Wiley.

Miles, E. (1991). Visual dyslexia/auditory dyslexia: Is this a valuable distinction?, in: M. E. Snowling and M. E. Thompson (eds.), *Dyslexia: Integrating theory and practice*. London: Whurr.

Miles, T. R. (1983). *Dyslexia: The pattern of difficulties*. Oxford: Blackwell.

Miles, T. R. and Miles, E. (1990). *Dyslexia: A hundred years on*. Milton Keynes: Open University Press.

Nadioo, S. (1972). *Specific dyslexia*. London: Pitman.

Orton, S. T. (1937). *Reading, writing and speech problems in children.* New York: W. W. Norton.

Prakash, P. and Joshi, R. M. (1989). Language representation in Kannada, a South Indian Language, in: P. G. Aaron and R. M. Joshi (eds.), *Reading and writing disorders in different orthographic systems.* Boston: Kluwer.

Ramaa, S. (1985). Diagnosis and remediation of dyslexia: An attempt. Unpublished Doctoral dissertation, University of Mysore.

Ramaa, S. and Lalithamma, M. S. (1987). An alternative explanation to the errors committed by dyslexics while recognizing Kannada words. Paper delivered at the 3rd World Congress on Dyslexia, Crete, Greece.

Raven, J. C. (1962). *Coloured progressive matrices.* London: H. K. Lewis.

Stanley, G. V. and Hall, R. (1973). A comparison of dyslexics and normals in recalling letter arrays after brief presentation, *British Journal of Educational Psychology* 43: 301—304.

Stanovich, K. E. (1991). The theoretical and practical consequences of discrepancy definitions of dyslexia, in: M. E. Snowling and M. E. Thomson (eds.), *Dyslexia: Integrating theory and practice.* London: Whurr.

Thompson, M. E. (1990). *Developmental dyslexia: Its nature, assessment and remediation.* London: Whurr.

Vellutino F. R. (1979). *Dyslexia: Theory and research.* Cambridge, Mass.: M.I.T. Press.

Vellutino, F. R. (1987). Dyslexia, *Scientific American* 256(3): 20—27.

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