A FRAMEWORK FOR TESTING KANNADA READING ON THE BASES OF AUTOMATICITY, RULES OF ORTHOGRAPHY, AND SEQUENTIAL FROCESSING

by

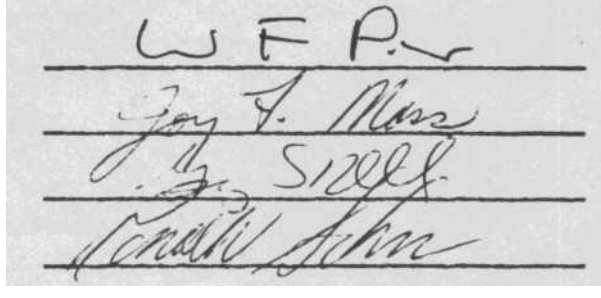
G.Purushothama

Submitted in Partial Fulfillment
of the
Requirements for the Degree

DOCTOR OF EDUCATION

The University of Rochester
Rochester, New York

1986



Curriculum Vitae

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ABSTRACT

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Abstract

The purpose of this study was to differentiete the good and poor reading Kannada children on the bases of the factors of automaticity, rules of orthography, and sequential processing. The relationship of the strategies of simultaneous and sequential processing to reading was also looked into.

Kannada is a Dravidian language, written in a Phonetically regular script. The script has a 50 letter alphabet and involves a large number of regular and irrerular rules in forming syllables.

Two groups of grade III children, 10 good achievers and 10 poor achievers, aged eight years, served as subjects. The subjects were tested for automaticity in reading (words and syllables exposed for one half a second) and reading at their own pace. The subjects were also tested for their nonverbal sequential and simultaneous strategies using the tests — Auditory Sequential Memory; Visual Sequential Memory; Raven's Progressive Matrices; and Memory for Designs.

Using ANOVA, with repeated measures on one factor, it was found that the groups were significantly different in the automatic processing of reading stimuli. The poor readers scored significantly less in reading the following;

words using orthographic rules, syllables with orthographic rules, and words of alphabet letters. The relationship between reading and sequential processing was not significant for either group. However, interestingly, some difficulties of sequencing in reading, words as well as reversals in reading of certain letters and diacritical features were observed in both groups. The relationship found between reading and simultaneous processing was not consistent. Good reading was correlated with automaticity in reading as well as the knowledge of the rules of orthography but not with sequential processing. It is suggested that the factors of automaticity and the knowledge of the rules of orthography can be used in differentiating good and poor readers of Kannada.

Table of Contents

List of Tables **Page**

List of Figures

INTRODUCTION

There is a need for instruments in evaluation of reading in the language Kannada. It is important to differentiate good readers from poor readers. Identifying poor readers should depend on the criteria of factors which contribute to normal skilled reading. Diagnosing the areas of strengths and weaknesses in reading will lead to the therapeutic work among poor readers. This study concerns building a framework for testing Kannada reading based on the criteria of certain factors that research has identified as important for reading.

Speech and language are universal. Difficulties in reading also seem universal. The claim that some orthographies are better than others and that orthographies are the determining features for the incidence of reading difficulties across cultures has been questioned (Stevenson, Stigler, Lucker, and Lee, 1982.). However it is also known that orthographic variations affect cerebral processing, memory functions, problem solving strategies, and pathways for lexical access (Tzeng and Hung, 1981.). Tzeng and Hung (1981) state that the "Human information processing system has been found to depend on written language to the extent that it happens to use the machinery of that particular communicative system" (p 253). Whatever the nature of difficulties, some children, in every language that is written, have problems in reading or acquiring the ability to read.

1. Reading Difficulties in India.

Thorndike (1973) in a survey of 15 countries on reading comprehension has shown that children in India were the poorest readers. Oomen (1973) points out that to a great extent school failure in India is probably due to poor reading achievement. However there are many other important factors such as socioeconomic considerations which may be highly contributory to the school failures apart from the reading disability. There are no formal provisions for children who fail in reading. Those children who fail are retained in the same grade until they show improvement.

2. Reading Difficulties in Dravidian Languages.

Indo-Aryan languages (Hindi and others) are spoken in the northern part of India. Dravidian languages are spoken in the southern part of India. There are four major Dravidian languages which are written: Kannada, Tamil, Telugu, and Malayalam. Of these languages, Kannada and Telugu have highly phonetically regular scripts. A study by Aaron (1982) recorded the difficulties in reading of Tamil children. Aaron stated that about 10% of children have difficulties in reading. Although children reading or learning to read Kannada have been observed to have difficulties, no studies on reading difficulties have been conducted. The present

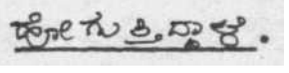
study concerns the language Kannada.

3. The Language Kannada.

Kannada is one of the major Dravidian languages spoken and written in south India, spoken by 15 million people. The language has a written history dating 500 A.D. Two major dialects, northern and southern, have been found. However, the literary form used in literature, newspapers, and writing is relatively uniform throughout the north and south Kannada dialect speaking areas (Nayak, 1967).

Kannada is a highly inflected language, that is, a verb in a sentence also carries the forms of tense, gender and singularity/plurality. For example, HOGUTTIDDALE - (she is going)

1. HOGU - (go)
2. HOGU+UTTA - (going)
3. IR - (to be) + ALE - (she is) = IDDALE
4. HOGUTTA + IDDALE = HOGUTTIDDALE - (she is going)

The script is also syllabic. Thus the word 'hoguttiddale' is written in five units: ho gu tti dda le. Written in Kannada it looks  In similar ways there are derivations and suffixes which render the word order in

sentences to less restriction. The word order when changed does not change the meaning. For example, AVALU MANEGE HOGUTTIDDALE - (she home to is going (feminine)) (she is going home). The alternative arrangements do not change the meaning.

AVALU HOGUTTIDDALE MANEGE
MANEGE AVALU HOGUTTIDDALE
HOGUTTIDDALE AVALU MANEGE
HOGUTTIDDALE MANEGE AVALU
MANEGE HOGUTTIDDALE AVALU

The alternative arrangements are used to help stress the intended part of the message. The intonation pattern of Kannada is said to emphasize the first syllable of the utterance.

Words and utterances in Kannada always end with vowels. Unless specially called for even the borrowed English words like, bus, school, etc. are modified to end with vowels.

4. Reading in Kannada.

As indicated earlier, writing across dialects is similar. However, there is a difference between the colloquial and literary Kannada. The spoken form has more variants than the literary form, more consonant clusters occur in spoken

Kannada than in written form (Nayak, 1967). There is also a trend to write in the colloquial form.

The population speaking Kannada constitute the political state Karnataka. Karnataka has a uniform school system. Children enter school after the age of five and a half years. Preprimary education is not a norm though it occurs in urban areas. Thus a child entering school at first grade does not necessarily know the alphabet. For two decades the teaching method has been the "whole word method". But as Oomen (1973) points out, the change of method is in name only and children are invariably taught using a synthetic approach. Reading is always oral; silent reading is nonexistent in the primary grades (1—7).

5. Kannada script.

Kannada script is syllabic. The syllables are vowels or different combinations of consonants and vowels (cv, ccv, or cccv). The alphabet of Kannada has 50 letters (16 vowels and 34 consonants). The letters do not have separate names; the sounds they represent are their names. There are no different cases as capital letters or small letters. Also there are no italic type faces. There is no cursive writing; it is always printed. The alphabet is presented in Figure 1.

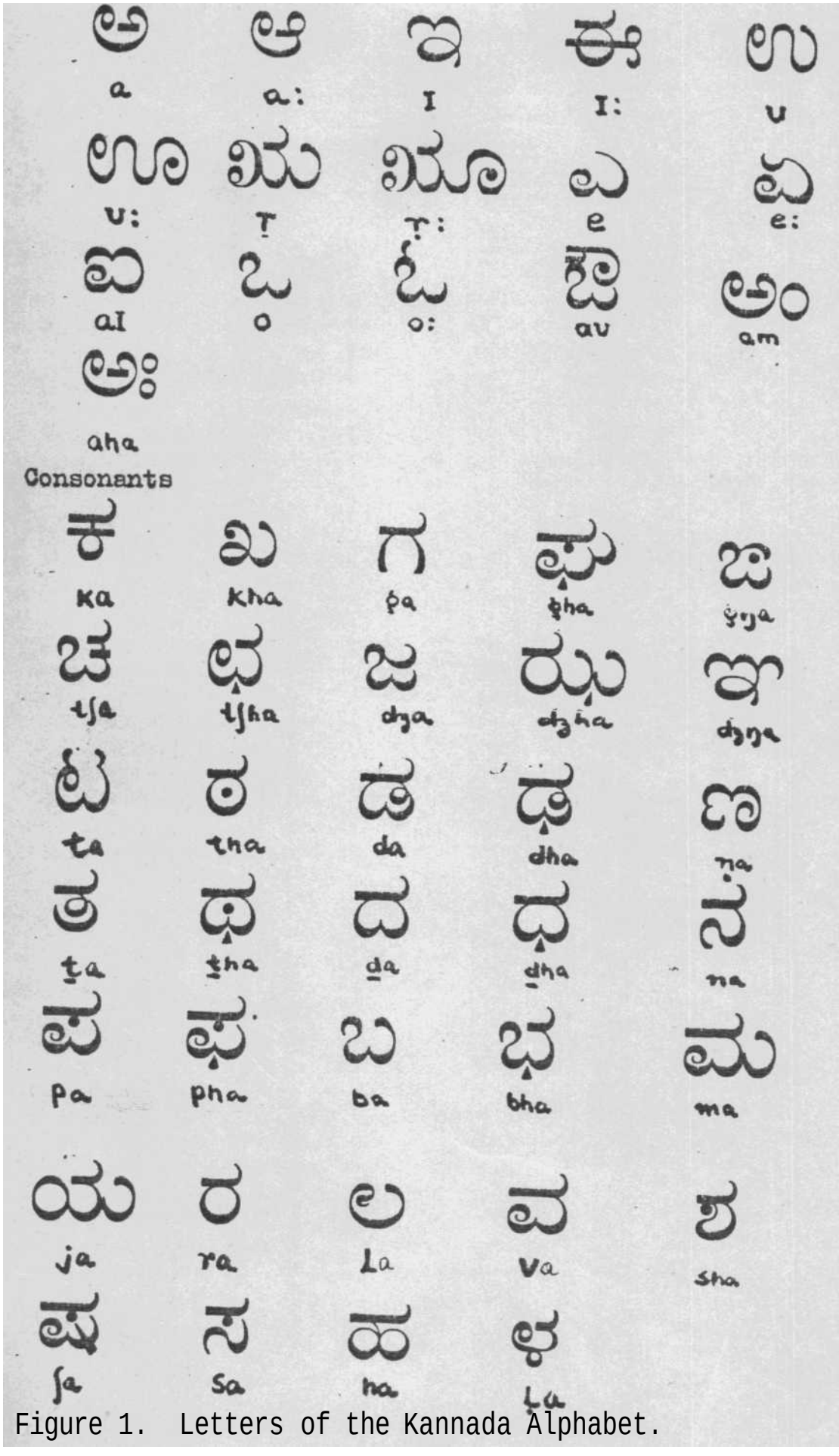


Figure 1. Letters of the Kannada Alphabet.

> The graphemes may be conveniently classified into vowels and consonants on the basis of this definition: The vowels are the independent graphemes which occur only in the initial graphemic syllable of a graphemic word, and a graphemic word is that which occurs between any two consecutive spaces. Except in the initial graphemic syllable of a graphemic word, vowels are invariably expressed through allographs. All those other than the vowels may be called consonants. The consonants or the consonant clusters in the initial, medial, or the final syllable of a graphic word are invariably followed by an allograph of a vowel. That is, no consonant occurs in isolation except in cases of writing of certain loan words, or in cases of specially intended situations. (Rajapurohit, 1975, p 138).

Consonants are pronounced with the short vowel (a). The allograph of the vowel (a) which is written as ـِـ appears in the top portion of most consonants. There are 8 exceptions among 34 consonants where this allograph does not occur.

The allographs of vowels do not necessarily have any visual similarity with the respective vowels in the alphabet. The allographs or the diacritical visual features of the vowels are presented in Figure 2. along with their respective vowels.

6. Syllables.

Bach consonant given in Figure 1 can be written to sound with any of the fourteen vowels using the diacritical markers given in Figure 2. Such functions will be illustrated here.

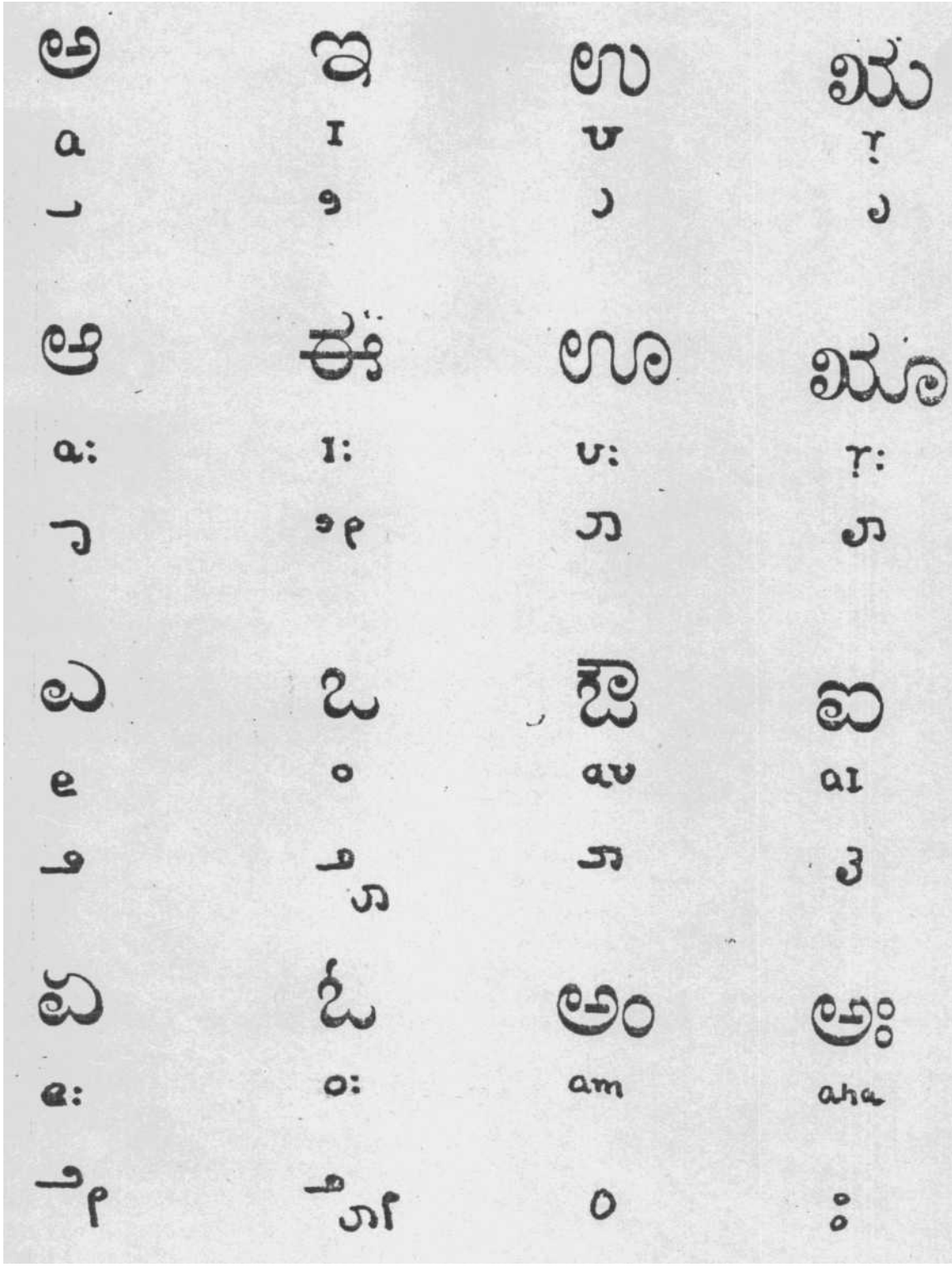


Figure 2. Kannada vowels and their allographs.

6a. First let us look at a consonant being ligatured with vowels on a regular basis. Let us consider the first consonant ಕ (ka).

1. ಕ (ka) which already has allograph ↵ representing ಅ becomes

2. ಕಾ(ka:) with the diacritical marker ಾ representing ಆ and
3. ಕಿ (ki) " " " " ಿ " ಇ "
4. ಕೀ(ki:) " " " " ೀ " ಈ "
5. ಕು(ku) " " " " ು " ಉ "
6. ಕೂ(ku:) " " " " ೂ " ಊ "
7. ಕೃ(kr) " " " " ೃ " ಋ "
8. ಕೄ(kr:) " " " " ೄ " ೠ "
9. ಕೆ (ke) " " " " ೆ " ಎ "
10. ಕೇ(ke:) " " " " ೇ " ಏ "
11. ಕೈ(kei) " " " " ೈ " ಐ "
12. ಕೊ(ko) " " " " ೊ " ಒ "
13. ಕೋ(ko:) " " " " ೋ " ಓ "
14. ಕೌ (kou) " " " " ೌ " ಔ "
15. ಕಂ(kam) " " " " ಂ " ಅಂ "
16. ಕಃ (kah) " " " " ಃ " ಅಃ "

There are regularities in the above example but they are all conditional regularities. The prolongation marker ಾ (in 2) above holds good only when short vowels are (a), (u) and (r) (1, 5, and 7). One can notice however, that the marker ಾ

does exist with the markers for (o) and (o:) (12 and 13) but does not represent prolongation.

Another marker of prolongation ೀ holds good only in the condition of (i), (e) and (o:) (3, 9 and 12). The marker ು is nonfunctional in (u) and (u:) (5 and 6). Similarly the marker ೊ does not seem to function independently in (kei), (ko) and (ko:) (11, 12 and 13). Thus the diacritical features are associated with each vowel and the visual regularities are not real ones. The system requires learning of rules and exceptions.

6b. We have seen the example of a consonant to which the ligaturing of markers was relatively regular. Now let us see an example where the ligaturing is not regular. For example consider the consonant ಮ (ma).

1. ಮ (ma) has the marker ್ and
2. ಮಾ (ma:) has the marker ಾ but it is ligatured to its side instead of its top
3. ಮಿ (mi) has the marker ಿ and
4. ಮೀ (mi:) " " " ೀ "
5. ಮು (mu) " " " ು "
6. ಮೂ (mu:) " " " ೂ "
7. ಮೃ (mr) " " " ೃ "
8. ಮೄ (mr:) " " " ೄ "
9. ಮೆ (me) " " " ೆ "

10. ಮೇ (me:) has the marker ೇ and

11. ಮೈ (mei) " " " ೈ "

12. ಮೊ (mo) " " " ೊ but a part of it is dropped otherwise which it should have looked ಮು similarly

13. ಮೋ (mo:) has the marker ೋ but a part of it is dropped otherwise which it should have looked ಮೋ

14. ಮೌ (mou) has the marker ೌ but it is ligatured to the side instead of its top.

15. ಮಂ (mam) has the marker ಂ and

16. ಮಃ (mah) " " " ಃ .

There are two more consonants which follow this kind of rule. There are seven other consonants which need a slightly different way of ligaturing. Thus there are ten consonants which need irregular ligaturing. If these exceptions are not deliberately introduced these rules can be turdles in learning to read syllables. Figure 3 gives a list of possible combinations which children may learn to read to become adept with the rules of ligaturing of diacritical vowel features with all consonants. Children rote learn to read all possible combinations of the consonants and vowels even when many of them are never used.

6c. Geminating consonants or clustering consonants (ccv) is a relatively easy task compared to forming different

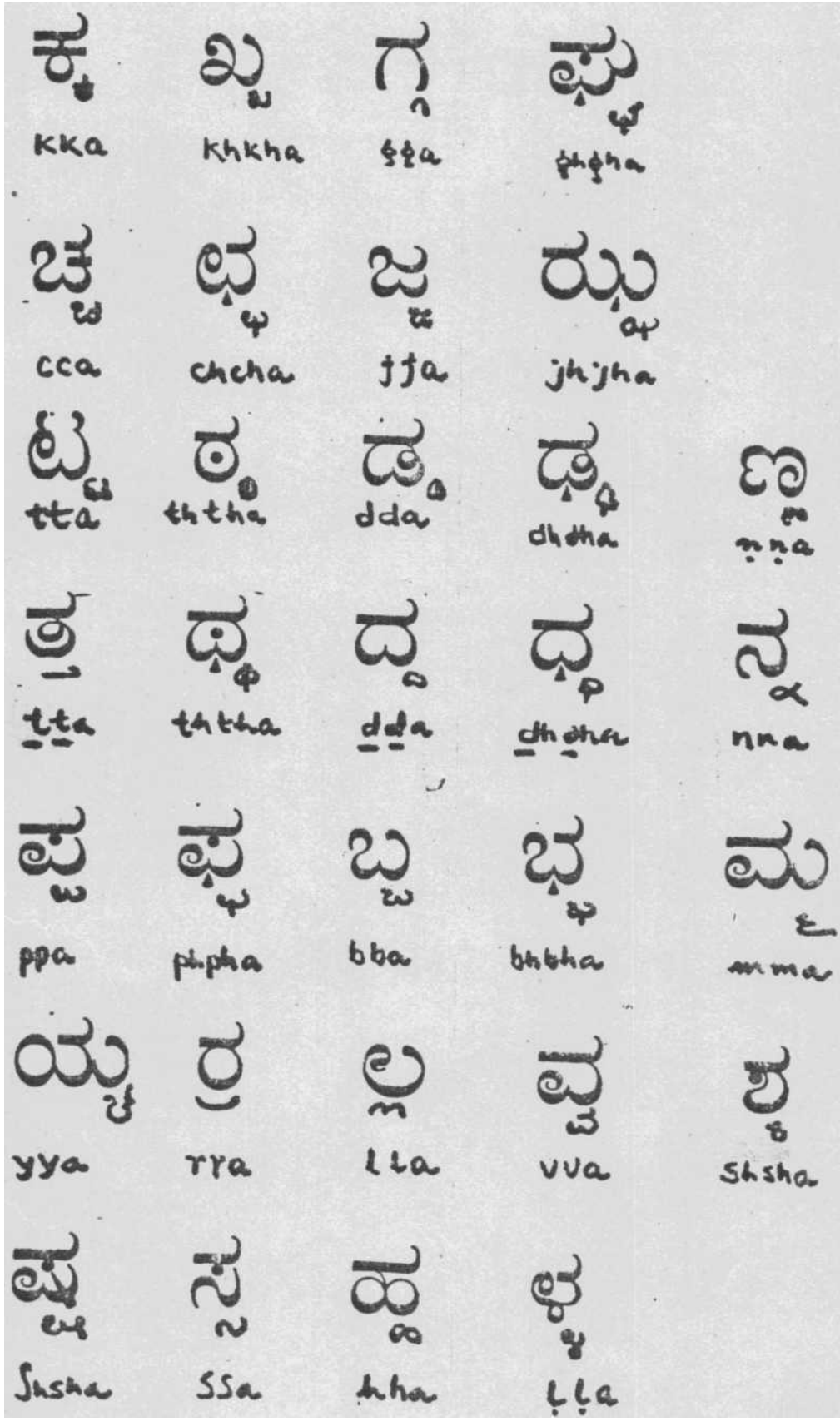


Figure 3. Kannada consonants with their allographs.

consonant-vowel combinations. Figure 4 gives a list of consonant allographs with respective consonants. As they are presented they are all geminated consonants with the vowel (a).

Forming blends is easier. The second consonant to be clustered is written below the given syllable (cv). For example, *

ಕ (ka) with the sign ್ (t) below it is read ಕ್ತ (kta).

As one may notice in Figure 4 most of the allographs are the consonants written without the vowel marker ್ for (a). However there are 7 allographs which do not resemble the consonant letters.

Children are introduced to the blends in progression as they learn to read. The blends occuring in the written form are less in number compared to those occuring in speech.

6d. There also occur some cccv blends in writing syllables. For example, ಕ್ಷ್ಮಿ (kshmi), ಶ್ಚ್ರ (shtra). They are few in number and thus may not be a problem in acquisition.

6e. Interestingly, some syllables can be written in two ways,
example 1) ರ (ra) has two allographs ರ, ಽ
thus, ರ್ಕ (rka)
and ಕ್ಽ (rka) forms are possible.

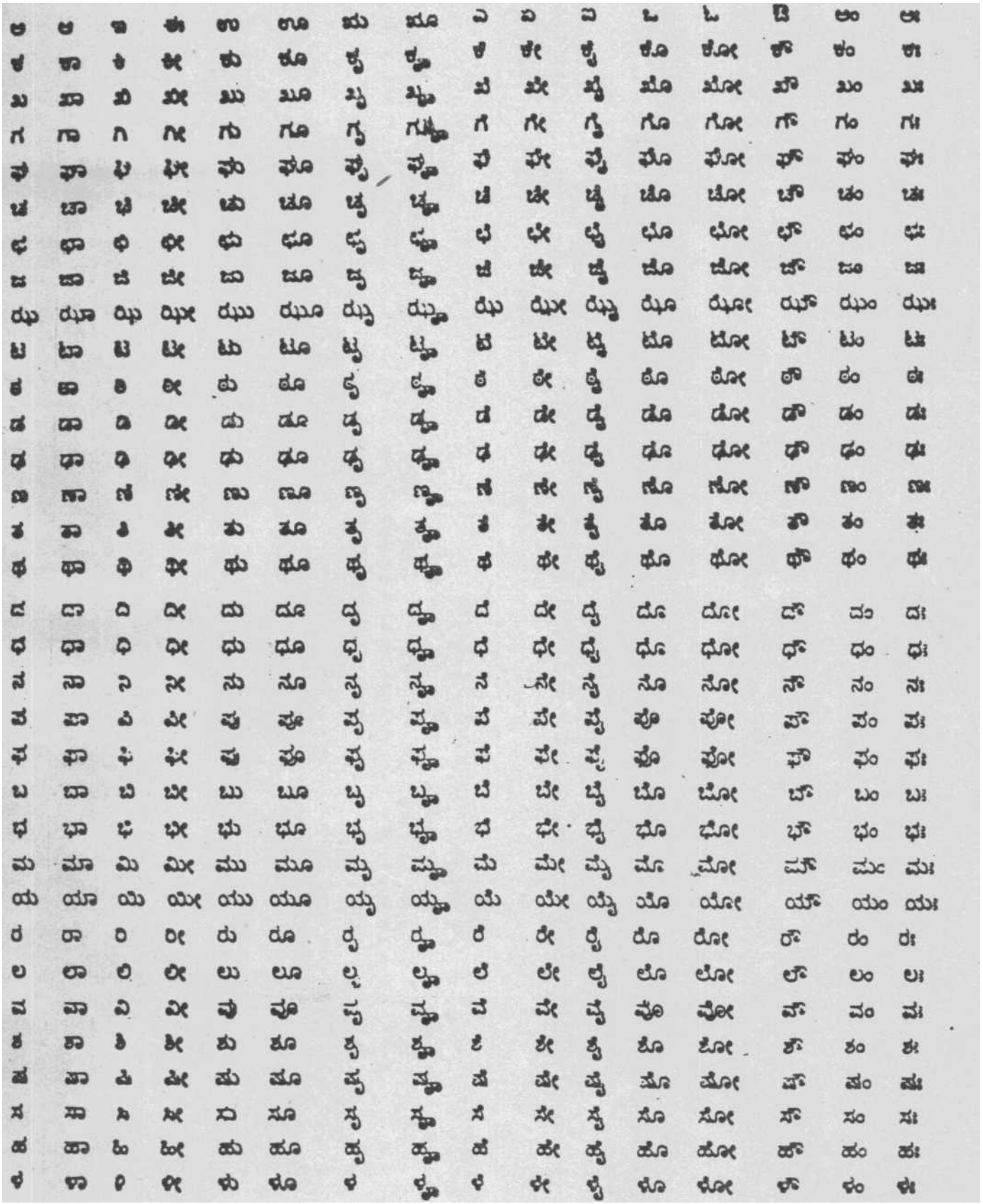


Figure 4. Kannada consonants with various vowels.

Whereas in the first instance the consonant forms the first marker of ccv syllable in the second instance the consonant allograph forms the second marker in the written forms.

example 2) the prolongation markers ಾ or ೀ can be used in some instances at ones preference. ಮಿಾ (mi:) ಮೀ or (mi:). However such alternatives are few and thus may not be a problem for a child who is adept at rules of forming syllables.

7. Acquisition of Reading.

The process of reading may not vary in different languages. Tzeng and Wang (1983) found that in every type of writing system the reader always has access to.the phonological information. It is possible that the process of learning to read may be different in different scripts. Different scripts represent the language at different levels. For example, when written, English is represented by phonemic (and morphemic), Kannada by syllabic, and Chinese logographs by morphemic scripts. However, learning one script is not easier than learning any other script. Some children will have difficulties in learning to read irrespective of the nature of the script (Stevenson, et al, 1982). Thus, it is more important to look at the needs and stages that children go through in reading than to look at the nature of the

script alone. Walcutt, Lamport, and McCracken (1974) state that reading begins when a child understands a word that he reads but does not hear spoken. Late in second grade, perhaps, but surely by third grade the child who has learned to read successfully will be encountering hundreds of words that he does not use and probably does not hear spoken.

Researchers have noted that there are several important factors which contribute to the development of normal reading. Early work on reading and reading difficulties tended to relate perceptual motor factors to reading. Later studies approached reading from different perspectives trying to understand the reading process through an information processing approach. The information processing approach seems useful not only in understanding but also in treating the disorders in acquisition of reading.

8. Perceptual Motor Factors.

The mechanics of reading requires the development of visual perception, auditory perception, language, motor abilities, and experience (Huus, 1972, Jansky & DeHirsch, 1972). Support for these factors comes from theories which have correlated reading disorders with other disabilities. Different visual factors have been implicated by Barsch (1967), Frostig (1973), Getman (1965) and Kephart (1971).

Auditory factors have been implicated by Johnson and Myklebust (1964), Kochnower (1983), Lyon (1977), and Wepman (1975). The importance of general motor abilities has also been suggested by Ayres (1968) and Delacato (1963). The importance of language in reading process has been implicated by many (Liberman, 1983, Vellutino, 1979, and Wiig and Semel, 1976).

Among theories, those presented by Getman, Kephart, Frostig and Barsch have not been supported, and visuomotor processes and the process of reading have not been significantly related (Hammill, Goodman, and Wiederholt, 1979). Hammill, and Larsen (1974) reviewed 33 studies on auditory perceptual skills and found that they are not sufficiently related to reading. They examined audiovisual integration, sound blending, auditory memory, phonemic discrimination and nonphonemic discrimination. Except for sound blending, a factor seen in two studies, the correlations were not significant. Hammill and Larsen considered these two results spurious as one study did not control for mental ability and the other did not reach significance at an acceptable level.

Kavale's (1981) analyses of 106 studies on auditory perceptual skills found that auditory discrimination, auditory sound blending, and auditory memory were significantly related to reading achievement. However, these

auditory perceptual skills shared a common variance with IQ when related to reading ability.

The relationship of auditory abilities to reading seems to hold only when subjects are young (Lyon, 1977). Poor ability to parse phonemes and reading disorders seem to co-exist. (Hasbrouk, 1983, Kochnower, et al. 1983).

Unlike the perceptual motor factors the linguistic aspects seem to be related. Vogel (1983) found quantitative differences in the development of morphological rules among reading disabled children when they were compared to readers without learning problems. Vogel found that children with reading disabilities exhibited a delay in the acquisition of these rules. Wiig and Semel (1976) found a significant relationship between measures of comprehension and expression of syntactic structures among reading disabled children.

9. Information Processing.

The aspects of visual perception, auditory perception, motor and language abilities are broad factors to be studied as individual components. In recent years studies on reading have examined the process of learning rather than modalities, particularly through an information processing approach. That is, learning per se is examined rather than

the visual, auditory, language or motor aspects of the learning process.

Information processing is the way of acquiring, retaining and recalling information for use. Learning to read is an example of information processing. Many stages in this process of learning are theoretically proposed. Structural features are the built in processes and the physical systems that do not vary among situations. Functional variables are those which make use of the structural features. Information input, attention, short term memory, learning strategies, long term memory, and metamemory are some concepts generally used when explaining how learning occurs. These aspects can be applied not only to learning among normal individuals but also among individuals with learning problems (Hall, 1980). There may not necessarily be deficiencies in certain variables like short term memory (Torgesen, 1982) and processing space/ capacity but in their use (Brown, et al. 1983). Many researchers have found that individuals with poor information processing ability, may be the ones who are poor in the "active interaction with the information about their world" (Hall, 1980, p 84). Findings by Hagen, et al (1982), Krupski (1980), Pressley, et al (1983), Reid, et al (1981) and Torgesen (1982) are in support of this view.

10. Attention and Automaticity.

Ross (1976) contends that in the process of learning, and particularly in learning to read, attention iB important. Attention is essential if stimuli are to be processed and retained in memory so that learning can occur. Once learned, the stimuli should not only become meaningful but also attract less attention to themselves unless called for, permitting automatic apprehension. This concept has been adequately used in explaining the reading process (LaBerge and Samuels, 1974, Roth and Perfetti, 1982, Shiffrin and Schneider, 1975). For example, LeBerge and Samuels (1974) state that

> During the execution of a complex skill, it is necessary to coordinate many component processes within a very short period of time. If each component process requires attention, performance of the complex skill will be impossible, because the capacity of attention will be exceeded. But if the enough of the components and their co-ordination can be processed automatically then the load of attention will be within tolerable limits and the skill can be successfully performed. Therefore one of the prime issues in the study of a complex skill such as reading is to determine how the processing of the component subskills becomes automatic. (p 293).

For normal fluent reading automatic extraction of information from print is essential. Normal reading may not be possible if the learner fails to extract complex stimuli automatically and simultaneously.

Automatic processing and simultaneous/parallel processing of stimuli are similar concepts. Cummins and Das (1977) and Das and Cummins (1982) have studied children processing reading stimuli serially and simultaneously. They argue that reading disabled children process reading stimuli using simultaneous and serial strategies but do so inappropriately. In their study the reading disabled children were found to be poor in serial processing though good at simultaneous processing. Condry, McMahon, and Levy (1979), Guttentag and Haith (1978), and Stanovich, et al, (1981) found that normal reading development in their subjects was associated with the development of automaticity. For example, words interfering with the task of naming pictures. Lesgold and Curtis (1981), Perfetti and Roth (1981), and Schwartz and Stanovich (1981) found poor readers reading at a slower rate by deploying more attention to the decoding process. It has been argued also that unless the process of extraction of stimuli becomes automatic, comprehension gets affected (Guthrie and Tyler, 1978, Perfetti and Roth, 1981, Stanovich, 1981). Many researchers found that good readers extract information quickly from print and also comprehend it (Chabot, Zehr, Prinao, and Petros, 1984, Schwartz and Stanovich, 1981, and Stanovich, 1981). Thus, a child learning to read must learn to identify the stimuli in units serially in the beginning, and with practice, learn to identify the same stimuli simultaneously

and automatically to become a normal reader.

11. Rule Learning.

The way a novice becomes an able normal reader, possessing the ability to process information automatically, is interesting. Jackson and McClelland (1979) concluded that the ability to comprehend spoken material and the speed of accessing the overlearned memory codes for the visually presented letters represented two important independent correlates of reading ability. Before children attend to the printed reading material they possess the ability to comprehend the spoken material. This is taken for granted when discussing normal reading acquisition.

At some stage, even if not the first one, it is necessary that children learn the units of printed code. Haber and Haber (1981) state that "There is overwhelming evidence that information processing of any kind is more accurate and faster when possible alternatives about the content to be processed are restricted" (p 168). Finite letters of the alphabet are the basic units which provide for the hierarchical system of reading. Both 'bottom-up' and 'interactive' models highly value the learning of the alphabet. Children do not have to learn how to recognize letters in the beginning of the learning to read process,

though they will eventually (Biemiller, 1970). Though every word is unique in its physical visual presentation, the enormous reading vocabulary children acquire can not be on the basis of the 'visual word' but on rules needed to decipher each one. Morrison (1984) states that "failure to acquire rule knowledge may hamper the growth of automated word decoding operations, thereby preventing development of sophisticated comprehension skill". Children normally learn sound-symbol correspondences and the orthographic rules which facilitate each correspondence. Children must not only learn the rules of spoken language, but must also learn how to apply them to reading apart from using the orthographic rules. Johnson and Hook (1978) agree that "both oral language and reading tasks involve abstraction and application of rules". Massaro and others (1980) in a series of experiments have shown the seminal role of ortho-graphic rules in reading. The role of orthography has been similarly supported by others (Baron, 1977, Carr, et al, 1979). The developmental nature of orthographic rule learning has been studied by Guttentag and Haith (1978), Lefton and Spragins (1974). The orthographic structure provides for the pronunciability (Spoehr and Smith, 1975) and syllabication (Taft, 1979) accounting for the reading ability. Also the orthographic structure seems to be related to reading achievement (Allington, 1978, Leslie and Shannon, 1981) and holistic processing (Samuels, et al (1978).

According to Morrison (1984) disabled readers experience particular difficulty learning associations that are governed by rules, particularly if those rules contain exceptions or inconsistencies. Velutino and Scanlon (1984) agree that poor readers are not always sensitive to the regularities in complex representational systems, regularities that can be translated into generative rules for economic analysis in reading. Moreover, Velutino has contended that it is in the 'visual verbal' learning that poor readers have problems consistent with the rule learning idea.

Gibson and Levin (1975) state that the ability to process information with increasing economy is developmental, that is, the ability to take advantage of rules and structural redundancies in the information increases with age. They indicated that "The task of perception is the search for invariants; for the permanent features that distinguish things, the order and structure in stimulus information, and the predictable relationships within events" (p 46). On these lines many researchers have proposed that instruction in decoding skills should be rule based and orthographic knowledge emphasized for educational practices, particularly for the reading disabled (Beck, 1981, Chall, 1983, Guthrie and Siefert, 1978, Guthrie and Tyler, 1978, Menyuk, 1976, and Resnik and Beck, 1976).

12. Reading and Reading Difficulties in Kannada.

The foregoing factors, rule learning, attention,and automaticity are, apart from the linguistic and environmental factors, essential for the development of reading ability. Learning to read encompasses all these factors irrespective of the nature of script that a child encounters.

13. Requirements for Oral Word Reading.

As mentioned earlier word order is not crucial in reading Kannada. Words are highly inflected. Thus reading at word level is considered here as primarily important. To read words fluently the reader needs to be aware of and adept at: (a) the components of orthography, (b) the rules for forming syllables, (c) processing the components of the syllables in the right order, (as in a blend "kta" for example), (d) processing the syllables in the given order, and (e) processing words automatically.

14. Observed Reading Difficulties.

Palindromes do not occur in Kannada frequently (in English, for example, WAS may be read as SAW). This is because the letters of the alphabet do not always occur as they are, they are changed with different vowels and consonants. Thus such misreadings are almost never observed.

Spelling problems are not observed as much in Kannada as in English. Phonetically regular misspellings in the written form are seen, e.g., one may write using spoken form instead of literal form. Misspelling in Kannada is comparable to phonetically regular spelling errors in English. Orthographically illegal writing errors may be there, but there is no formal analysis of error patterns available. However specific spelling difficulties which are observed in fluent readers of English may not be a possibility in Kannada. The absence of unique spelling problems may be because spelling itself is reading!

Beginning and poor readers tend to "spell out" words before reading them. They may actually describe each syllable in terms of its components. It has been observed that poor readers misread words depending entirely on context. This would be akin to a child reading in the first stage of reading acquisition.

Aaron (1982) observed reading difficulties in children reading Tamil, a related language to Kannada. He found that the phonetic regularity of the script did not eliminate reading problems. He observed sequential processing difficulties. In reading inflected words, children did not process the syllables sequentially, they omitted suffixes or inflections which lead to agrammatism. Children read nongrammatically as they depended on sight words at the cost

of processing the details.

It is clear that children learning to read would be impeded if their learning is affected in terms of acquiring automaticity, rules of orthography, and sequential processing in reading. It is important that children exhibiting reading difficulties are examined for these factors as a first step in evaluating and ameliorating their problems.

15. A Framework for Testing Kannada Reading.

The earlier description of Kannada script indicated that children learning to read have to learn a large set of explicit rules of syllabication. Also they need to learn a number of irregularities in the application of these rules. Apart from the specificities of the script, the following observations from the literature highlight the important factors to be focused on in this study.

1) It is possible that children having difficulties in reading have problems in learning the rules of orthography or applying them in reading. (Morrison, 1984).

2) It is possible that children having difficulties in reading have problems in processing the syllables in words

in the right sequence though they can read each syllable correctly. (Aaron, 1982).

3) It is possible that children having difficulties in reading have problems in processing words serially but are able to process them wholistically inappropriately. (Das and Cummins, 1982).

4) It is also possible that children having difficulties in reading are aware of all the invariant rules and are able to process syllables sequentially but not able to read words automatically. That is, given enough time the children may be able to read the words correctly, though slower. However an interaction of these above difficulties should be expected.

5) It is recognized that speech, language and available information store in children provide a general and a wider bearing for the processes of reading. (Johnson and Hook, 1978, Vogel, 1983, Wiig and Semel, 1976).

Figure 5 schematically represents the role of these important factors in the reading process.

In evaluating children with difficulties in reading it is important to identify or rule out the problems in acquiring automaticity, rules of orthography,and sequential

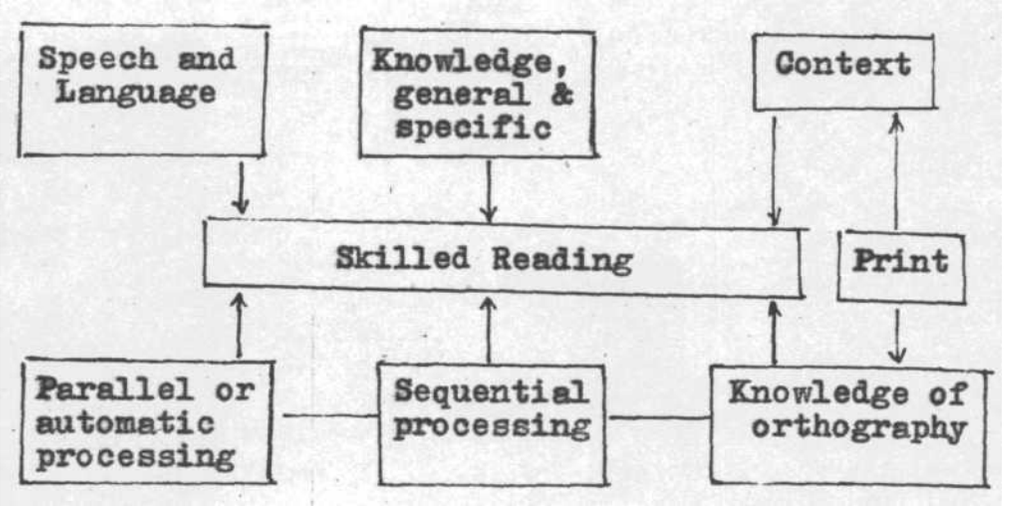


Figure 5. Scheme of reading having automatic processing, sequential processing, and orthography as important factors.

Speech and Language include processing of auditory, motor, syntactic, morphological and other linguistic aspects.

Knowledge refers to world knowledge and knowledge specific to the subject of reading.

Context refers not only to the subject of reading but also to the syntax which provides redundancy in sentences, available in the printed text.

Skilled reading refers to the normal, fluent reading.

Parallel or automatic processing happens when the subject needs to pay least amount of attention to the print being read.

Sequential processing refers to the appropriate order of processing letters/syllables in this particular case.

Orthography refers to the rules of graphic units in a script comparable to the phonemic order of that language.

processing before looking into the subtle problems in language and strategies of comprehension.

In this study it is intended that the differences in reading processes at word level be ruled out as a first step in evaluating the differences among good and poor readers in Kannada. Roth and Perfetti (1982) state that "Higher levels of comprehension may involve component process interactions analogous to those of word identification. Whereas word identification is the activation of a word concept in memory, comprehension is the construction in memory of conceptual configurations, including words" (p 17). As noted earlier word meaning contributes more in Kannada sentence comprehension than their order. Once the difficulties specific to reading at word level are examined, further it would be convenient and appropriate to look at other factors. Difficulties in language, vocabulary, strategies of content learning which are not apparent can be considered for evaluation in the next phase. Measuring the processes in word reading would also be useful in dealing therapeutically with affected children accordingly.

Building a framework for such a purpose in this case involves testing syllabication rules of Kannada, automatic reading (at brief exposures), and relating reading to sequential and wholistic processing strategies. It is

possible that good and poor readers of Kannada can be differentiated on the bases of these factors. This study is to test the following hypotheses with reference to reading Kannada.

I. Good readers will read words and syllables correctly and automatically.

a) Good readers will use all the rules of orthography (rules which are regular, irregular,and complex) compared to poor readers.

b) Good readers will read the components of the words in the right sequence. Reading the components of words in the right sequence will be related to their sequential processing of nonreading stimuli.

II. Poor readers will not read words and syllables correctly and automatically.

a) Poor readers will read correctly, when allowed longer time, compared to good readers.

b) Poor readers will not use all the rules of orthography as good readers do. They will not use the complex and irregular rules.

c) Poor readers will not read the components of words in the right sequence. Reading the components of words in the right sequence will be related to their sequential processing of nonreading stimuli.

REVIEW OF LITERATURE

The factors of attention, automaticity, sequential processing,and rule learning seem to be very important in learning to read a script. Findings on these factors are scanty in other languages than in English. Nevertheless it will not be improper to apply certain findings to other languages. The following review pertains to the role of the above factors in reading and learning to read.

1. Importance of Attention in Reading.

Lewis (1975) defines attention this way: "In its general sense... seems to be the process by which an organism directs its sensory and elaborating (cognitive) systems. This direction is in the service of all subsequent action, thought or affect." (p 144). Attention is the first, basic, and essential part of learning. There are always an abundant number of physical stimuli to attend to but one needs to attend to one stimulus at a time in order to learn. So, selective attention is a further nuance of the concept attention. Selective attention has been held as a factor important in learning to read (Ross, 1976, Schworm, 1982).

Selective attention is developmental, that is, with

age normal children develop the ability to attend to relevant stimuli in the background of irrelevant stimuli. Hagen and Kail (1975) observed that with increasing age children are better at central recall (intended central part) of the stimuli as compared to irrelevant incidental stimuli. Also, interestingly, over achievers in school seem to be better at central recall compared to average normals (Hallahan and Reeve, 1980). Similarly, Schworm (1982) found that higher achieving beginning readers attended to the stimuli selectively better than the average ones. Ross (1976) had hypothesized the similar trend that good students would start selectively attending to the stimuli much earlier than the normal and poor students. Lewis (1975) has proposed that a measure of attending would be revealing the cognitive functioning level of children and even infants. All these suggest that the process of attending is very important in a learning situation.

In a learning situation attention is needed so that all components of the stimuli may be received meaningfully. But once learning takes place one should be able to receive the same stimuli meaningfully deploying the least amount of attention possible. The concept attention is reciprocal to automaticity. Reading is a complex skill. LeBerge and Samuels (1974) propose that in processing a complex skill like reading components are processed automatically.

LaBerge and Samuels (1974) state that "It is assumed that we can only attend to one thing at a time, but we may be able to process many things at a time so long as no more than one requires attention." (p 295). That is, if the child has to read more than a word as in a sentence or more than a sentence as in a paragraph or a text, he needs to attend less and less to letters, words and sentences respectively. This idea has been well supported (Beck, 1981, Guttentag and Haith, 1978).

2. Development of Automaticity.

The development of automaticity has been established repeatedly by researchers. Beck (1981) found that first grade children responded immediately in a deciding task (determining quickly) whether words belonged to a category or not (e.g. animals). The frequency of occurance of words in the child's reading program was, of course, related to the speed of recognition showing that the previous encounters with a word contributes to the speed of recognition.

Guttentag and Haith (1978) found that after 9 months of formal instruction first grade children were able to extract meaning from familiar words automatically. These experimenters found that picture naming was interfered by

different stimuli. The stimuli: intracategory words, extracategory words, pronounciable letter strings, non-pronounciable letter strings, and non letter visual noise were printed over the pictures. The study revealed that even the poor readers of a third grade classroom could extract meaning automatically from the same stimuli, but they responded more slowly to pictures containing intra-category and extracategory words. Further, the experimenters suggested that the good readers were automatic decoders, whereas poor and beginning readers decoded unfamiliar letter strings much less automatically.

Stanovich, Cunningham, and West (1981) conducting a longitudinal study, on the development of automatic recognition skills in first graders, found that the development of automaticity reaches a plateau by the end of first grade with skilled readers showing this behavior more so than others. Stanovich, et al. observed an increase in interference in reading using the Stroop task. The subjects were required to name the color of letters, read highfrequency words and read lowfrequency words at different times in the school year. There was a marked increase in interference observed when tested between September and February but very little change between February and April indicating the automaticity reaching a plateau. Other studies also support these findings.

Friedrich, Schadler and Juola (1979) found that second graders could recognize words faster than syllables and letters. This ability was also true with fourth graders and college students. Similarly, Condry, et al (1979) reported that second grade school children in their study were able to select a given feature of words reasonably well, comparable to the performance of fifth grade and college students, though the older subjects were faster and more accurate. They used a set of tasks requiring subjects to decide whether the stimuli (words) were alike in looking, rhyming, and meaning.

Samuels, LaBerge, and Bremer (1978) observed that the latency of categorizing words of different length reduced across grades 2, 4, 6 and college. The college readers took almost the same time to read words of different length and there was a trend towards this goal observed at grades 4 and 6.

Above mentioned studies indicate that as readers progress through second grade to college their reading of words becomes so automatic that contribution of each letter code to the word code reduces and they will be able to process words wholistically as units.

3. Automaticity: A Stage in Learning to Read.

The foregoing indicated that the development of

automaticity occurs in reading as soon as children start learning to read. Some researchers have identified this phenomenon, the development of automaticity, in reading as one stage in the acquisition of reading (Chall, 1983, Fries, 1963). Chall (1983) and Fries (1963) proposed that a beginning reader, with practice, soon becomes able to read the print automatically, a condition which is a necessary part of reading acquisition.

According to Fries (1963), in the first stage of reading acquisition children learn to associate visual patterns that represent language signals with the auditory patterns that they replace. Fries noted that "The second stage covers a stage during which the responses to visual patterns become so automatic that graphic shapes themselves sink below the threshold of attention, and the cumulative comprehension of meanings signalled enables the reader to supply those portions of signals which are not in the graphic representations themselves." (p 132). The third stage begins when reading becomes so automatic that it is used equally with or even more than live language in the acquisition and development of experience. Fries recognized that at first reading demands conscious attention to the significant details of identification, however as the process becomes a habit such details of words should require less and less conscious direction.

Chall (1983) proposed several stages in development of reading which are akin to those of Fries, with stages 1, 2, and 3 to 5 similar to Fries'three stages. According to Chall, the first stage occurs when children learn to associate the arbitrary set of letters with spoken words. It is only at the end of this stage somewhere in first or second grade that children begin to learn about the spelling system of a particular language. In the second stage, which is still not for gaining new information children gain fluency and speed and begin to use context to recognize words. In this stage based on practicing high frequency words and decoding children gain fluency in reading. From stage 3 onwards reading is for learning. Reading to learn presupposes that the subject has been successful in acquiring skills in stages 1 and 2. Reading to learn comprises the learning of new meanings of words, multiple view points, and acquiring and broadening world knowledge. Chall stipulates that the passing successfully through stages 1 and 2 is important for basic literacy as one needs to be fluent in reading to acquire new information.

4. Automaticity: A Prerequisite for Skilled Reading.

Automaticity in reading is also related to comprehension. According to LaBerge and Samuels (1974) word meaning refers to the semantic referent of the word spoken or written, and

comprehension refers to the organization of those word meanings. Readers can attend to the visual structures of words and pronounce their phonological form without comprehending the message. Unless the words are automatically processed and attention directed to organize their meanings, comprehension may not occur. Durkin (1980) also has the same opinion: "To free a reader to attend to meaning, words must be identified "without thinking". Automaticity, therefore, is one requirement for successful reading". (p 302). Many researchers share this opinion (Carr, 1982, Chabot, et al, 1984, Lesgold and Curtis, 1981, Perfetti and Roth, 1981, Singer, 1982, Stanovich, 1982, and Williams, 1974).

Chabot, et al. (1984) found that reading achievement is significantly related to the speed of word recognition. They used college students as subjects who underwent the experimental task of deciding about whether the pairs of words presented were same or not in terms of visual identicalness, their names or their category. Chabot, et al. stated that the development of rapid word recognition skills was the primary factor which distinguishes skilled from less skilled performance. Reading deficiencies may also occur as a result of either slow semantic memory access or a lack of organization of information in semantic memory.

Williams (1974) noted that a difference in context use skills often explains the differences in reading ability. The ability to exploit context depends on the automaticity of the decoding process. In Williams' study subjects skipped every other line when reading paragraphs. The irrelevant lines were printed in red ink. Although good and poor readers made errors, good readers made more intrusion errors by reading the irrelevant words from the red print. Williams concluded that good readers have difficulty avoiding context, whereas poor readers can concentrate on decoding the print. While good readers decoded words automatically they could attend to words which were irrelevant but poor readers had to read slowly to decode and committed errors therein but not the intrusion errors.

Lesgold and Curtis (1981) have experimented to find if reading speed and verbal access speed are related to overall reading ability. They tested primary grade children for oral reading errors, verbal processing speed in visual matching, word matching, category matching, vocalization, and scanning through reaction time tasks. They found oral reading speed in the first year of reading instruction to be predictive of later reading achievement. High ability readers were faster than others. Readers were not differentiated for their ability on reaction time tasks.

Access to phonological code if inefficient may retard the process of learning to read but does not render reading itself that difficult once it is learned. The data, the authors note, is supportive of the hypothesis that slow reading means that greater cognitive capacity is required for word recognition, not that poor readers choose to allocate more capacity to this task.

Perfetti and Roth (1981) found that reading is an interactive process. Particularly poor readers are more dependent on context because of slow execution of the word level process. Highly skilled readers who process the words automatically are less affected by conceptually derived data. It was found that less skilled readers were very sensitive to context, they made better use of the context when reading the presented words than skilled readers. Skilled readers also take advantage of the context only if they have to read long and low frequency words. Older children third grade and beyond were found to be more proficient than younger readers in processing of printed words relying less on context. However skilled readers were also able to make use of context and depend less on it. In the context of high constrained sentences even less skilled readers performed well but it is the high skilled readers who performed well in predicting correct words in the context of moderately constrained sentences.

Whereas skilled readers could identify the visually degraded words even without context, less skilled readers could identify those words only with context. The experimenters found that skilled reading depended more on extracting the printed information further aiding in using context whenever needed. The authors concluded that less skilled readers are typically slower in word identification indicating the problem in automaticity. They also note that children do not have problems in using the context in word identification.

The majority of studies conclude that word recognition relates to reading ability and that recognition speed facilitates reading comprehension (Stanovich, 1982). Exploiting the use of context for comprehension is highly related to efficient, automatic decoding ability. Singer (1982) states that "if poor readers exhaust attentional information decoding individual words, they will be unable to devote any attention to context.....several research projects report an impaired ability of poor readers to exploit context" (p 65). It is also suggested that a critical goal of instruction should be to establish the automatic reading of print and integrate these skills in to already existing language comprehension process (Carr, 1982).

5. Automaticity and Strategies of Processing.

Automatic processing of stimuli may require simultaneous

processing. A process can be automatic and fast when the individual is not required to attend to each component but attends to the stimuli as a whole unit. This is also referred to as parallel processing. Automatic processing to be an efficient processing needs necessarily to be precise. Poor readers tend to read words wholistically but with errors. Children approach words wholistically in the beginning relying on context and then they learn the details, at a later stage they use both context and the knowledge of details (Beimiller, 1970, Chall, 1983, Elliot, Halliday, and Callaway, 1978). It is important that young readers learn the details precisely and well before the activity becomes automatic, otherwise that learning does not lead to normal and good reading (Aaron, 1982, Cummins and Das, 1977, Das and Cummins, 1982).

Elliot, et al, (1982) found that young children aged 7 to 8 years processed words similar to how adults process pictures relying on their right hemisphere functions. Older children aged 10 to 14 years processed words using left hemisphere functions. The oldest group of children aged 13 to 14 years processed the stimuli using both hemispheres. Reynolds (1981) indicated that left hemisphere and right hemisphere are understood to serve the functions of serial and simultaneous processings respectively.

Beimiller's findings concur with the ideas stated above on the development of reading in young children. He studied young children's oral reading errors during first grade from October to May. He found three stages in the development of reading. In the first stage children read with the aid of context and made very few graphical errors. In the second stage children made more graphic errors which he accounted for their using graphic information instead of contextual information only. In the third stage their errors were both contextual and graphical. Children's processing words in the beginning possibly wholistically with the help of context were eventually learning the details of graphic information and at a later stage using both wholistic and detailed processing strategies.

Though children come to process reading material wholistically they may not learn to process it efficiently to become skilled readers. Poor readers may be less skilled in processing the units of reading stimuli in a proper sequential manner.

Studies investigating the processing strategies were initiated almost a decade ago. Luria (1973) observed that the brain processes language in different ways. He reasoned that for understanding logico-grammatical relations, for instance, 'father's brother-in-law' and similar linguistic constructs an individual needs to process simultaneously,

whereas serial processing is needed for expressive speech.

Cummins and Das (1977) proposed that among less fluent readers successive or sequential processing accounts for more variance in reading than simultaneous processing though among fluent readers both kinds of processings may be used equally. In general, Cummins and Das indicate, particularly in young children, processing of linguistic input is likely to be more dependent on successive than simultaneous processing. In their later study Das and Cummins (1982) found that as reading disabled children mature they develop simultaneous processing skills and apply them to reading tasks but the successive processing abilities do not develop in the same way with age and are not successfully applied to reading tasks. In the study normal and reading disabled children underwent the task of Figure copying, Memory for designs, and Raven's progressive matrices for marking their simultaneous processing and Digit span forward, Serial recall, and sentence repetition for serial processing. When compared with normal readers the poor readers were not deficient in either processing but were limited in the extent to which they could make use of their successive processing skills in the context of reading. Only their simultaneous processing was associated with their reading success.

One study on reading has been undertaken with children who speak a Dravidian language. Aaron (1982) studied the reading of Tamil children to see if they have problems in sequential processing. The study was to see if children have sequential processing difficulties in reading a phonetically regular script as compared to children reading English. He found that phonetic regularity of the Tamil script did not eliminate the problem in reading when there were sequential processing difficulties. Children's reading errors were agrammatic. Aaron reasoned that this could be highly related to the nature of the language which is highly inflected. For example, see the construction in Tamil.

VASI-read
AVAN-he
VASIKIRAVAN-(VASI+KI+AVAN)-he who reads
UKKU-to
VASIKIRAVANUKKU-to him who reads.

In reading such an inflected word if the children do not process the syllables sequentially well they are bound to omit suffixes and inflections which leads to agrammatism. This happens if the children depend on the sight words and use only wholistic strategy to read, at the cost of the elements of the stimuli.

From the above findings it is clear that normally reading children do learn to process the reading stimuli wholistically or automatically. If children decode words automatically and correctly they will be able to attend to the organization of the sentence and higher units for comprehension. However, it is required that children should become adept with the internal structure of the words before becoming efficient readers.

6. Letter Knowledge.

Knowledge of the letters of alphabet has been thought of as a good indicator of reading development. DeHirsh, Jansky, and Longford (1966) found letter naming as one of the promising tests for predicting reading development. Lowell (1971) reported that among the predicting factors, knowledge of alphabet letter names is the only desirable factor for inclusion in reading readiness tests. Letter naming was the highest correlated factor. Naming letters incorporates visual and auditory processing which are highly related to reading. This finding was also supported by Leslie and Shannon (1931). They found that letter naming was the excellent predictor of success in learning to read. Letter naming was also the predictor of beginning knowledge of orthographic strupture which provides for the word recognition ability (correlated at .8 level). Also,

children who named fewer than half the number of the letters did not perform above chance level on the orthographic tasks.

Stanovish, Cunningham, and West (1981) found that children learned to recognize letters automatically by the end of the first grade itself. Letters were better automatized than highfrequency words. Less skilled readers did not show such automaticity in letter recognition. Authors stated that efficiency of letter processing continues as child keeps practicing reading. Reitsma (1978) found that, in children beginning reading English where letter names differ from the sounds and also where there are different case letters, name matching and visual matching changed with increasing grades. Children became efficient in extracting invariant features among irrelevant variations such as type face.

Letter-sound learning continues for quite some time atleast in children learning English as letters do not consistantly represent the same sounds. Venezky (1976) stated that

> The reliance on letter sound generalizations in word recognition decreases as word identification ability increases, and the mature reader probably makes little use of them in normal reading. Nevertheless, the ability to use the letter sound generalizations continue to develop at least through grade 8. Whether this is due to a

> continual reliance upon sounding out words or is a result of increasingly more efficient memory organization is not known. But since the use of letter sound generalizations appear to depend heavily upon examples stored in memory, organization probably accounts for a significant part of this development. (p 22).

Letter recognition in reading not only depends on the letters themselves but also on the higher order organization they themselves constitute (Leslie and Shannon, 1981, and Massaro, et al, 1980).

Letter recognition efficiency is found to determine the ability of the word recognition (Bouwhuis and Bouma, 1979) and of reading speed (Jackson and McClelland, 1979).

7. Syllable Reading.

Whenever acquired, either in the earlier stages of reading or later, depending on the method of teaching it is essential that a child learns all the units of the alphabet efficiently to become a skilled reader. A skilled reader does not read letter by letter but by forming higher order units of them for efficient decoding.

Learning syllables as units of spoken language seems to be natural and the most efficient way. This seems to be true with reading also. The surprisingly low percentage (less than 1%) of reading problems among Japanese has been

ascribed to the syllabic nature of the Japanese script (Makita, 1976). However, such high claim has been questioned.

Menyuk (1976) stated that analysis of speech takes place at an unconscious level in units of syllables. She suggested that initial exposure to written material should be organized in to written syllabic-speech correspondences, not letter sound correspondences, at least in case of children who find it difficult to further analyze speech into phonemic units. Durkin (1981) also points out that it is syllables that are decoded and not words and in order to move from spellings to pronunciations children need to know syllabication.

Liberman, et al, (1977) found that none of the children aged four years could segment speech by phonemes, whereas nearly half of them (46%) could segment words by syllables. Ability to carry out phoneme segmentation successfully did not appear until age five and then it was demonstrated by only 17% of the children. About half (48%) of the children at the age five could segment syllabically. Even at the age six only 70% succeeded in phoneme segmentation, while 90% were successful in the syllable task. This, the authors say, is because the phoneme boundaries are not marked acoustically owing to the coarticulation of the phonetic segments. For example, a consonant segment will be merged

with a vowel. Analyzing an utterance into syllables on the other hand may present an easier and different problem as every syllable contains a vocalic nucleus and a distinctive peak of acoustic energy. Groff (1978) found that poor readers attempted to use vowel letters as cues to word recognition.

Reading with phonetic processing is ideal according to Liberman and others (1977).

> Among the primary language processes that the child can exploit by conversions to speech (either analytically or wholistically) is the use of a phonetic representation to store smaller segments (words, for example) until the meaning of larger segments (phrases or sentences) can be extracted. Research on speech perception suggests that the phonetic presentation may be uniquely suited to such storage....now we have evidence that among second graders, good readers rely more on a phonetic representation than poor readers do. (p 223).

They state that phonemic representation is harder for young children and that a syllable based writing system would be easier to learn to read than those based on a phonemic alphabet.

Rozin, Poritsky, and Sotsky (1971) in their study showed that even reading disabled American children could be taught to read English material using 30 different Chinese characters. They reasoned that children were successful in

reading because Chinese characters represented morphemes and not phonemes, and suggest that a syllabary may be most useful in teaching reading.

Harrigan (1976) in a similar study could teach reading disabled American children to read English using Chinese ideographs. Similarly he suggested that for young children learning to read, phonemic abstraction will be difficult but not syllabication.

Treisman and Baron (1981) studied segmental analysis ability as related to reading ability and found that in first grade children syllable counting was significantly related to nonsense word reading. The results suggested that the ability to represent spoken words in terms of syllables is correlated with rule using ability.

Spoehr and Smith (1975) suggested that in recognizing words the perceiver first groups letter strings into higher order units (the parsing process) and then proceedes to decompose them into single letters or letter bigrams. They found that letter strings containing vowels were better perceived in the tachistoscopic tasks owing to the economy of perceiving syllables relative to letters per se (e.g., BLOST and BLST). In another experiment they observed that pronounciable letter strings were better perceived than others (e.g., ROST and RSOT). When subjects were permitted

to insert vowels to make pronunciable words they performed as predicted. Spoehr and Smith suggested that "one needs to start from a syllable in order to insure that the recoding process has the groupings it needs in applying rules of letter sound correspondence; hence the need to build up a syllable like unit before breaking it down" (p 33). This indicates that when processing a letter string as in reading readers depend on syllabication of the stimuli. Spoehr and Smith's suggestion is supported by the study in which the irregularly segmented words (e.g. RA NG ER) did not permit the subjects to read them fluently, probably as the syllabication was not possible (Schnider, Well, and Pollastek, 1974).

Katz and Feldman (1981) found that subjects used syllable information more when reading the phonetically regular Serbo-croatian words than when reading English. They tested American fifth grade children and adults in a task of reading regularly and irregularly divided words and pseudo-words (wa/ter, w/ater, and wu/ter and w/uter). Regularly syllabified stimuli were easier than the irregular ones. In the lexical access task where the subjects had to decide whether the stimulus was a real word or not, children appeared to process words based on syllabication. In the lexical decision tasks, the Serbo-croatian subjects were slowed by the disruption of natural syllabication.

8. Word Reading.

It is known that learning the letters of the alphabet and syllabication are important in learning to read. But once children become "readers" they read words as single entities. By this stage the children are aware as to why they read words as they are. That is, they do not necessarily read the words with the help of only context as they would have done in the very first stage of reading. At this stage the children are able to exploit language, world knowledge, with the given context of reading and their ability to process words from the level of letters, phonemes and syllables. Children not only learn by making use of what is printed but also what they already know which is termed as the process of "interaction" in reading (Rumelhart, 1977, Stanovich, 1984).

Osgood and Hoosain (1974) from a series of experiments concluded that words have a special salience in the perception of language and the reason for this salience is the unique meaningfulness of words as units. They state that the mechanism for this salience is the convergence of feedback from central mediational processes with feedforward from peripheral sensory processes upon the integration of word form percepts.

Since Cattel's time it has been known that words can be

read faster than letters. Also, letters can be identified faster in words than otherwise which is known as word superiority effect (Gibson and Levin, 1975). There is not only one explanation for the word superiority effect. Structure of the orthography is thought to be an important facilitating factor in word recognition.

9. Orthography.

Gibson (1969) found that as children learn to read they begin to generalize the recurrent clusters of letters as units and generalize such invariant units to reading. Skilled readers in English are more apt to perceive the letter strings which follow the rules of English orthography.

Massaro, et al. (1980) found that the knowledge of orthographic structure contributes an independent source of information about the letter string and thus reading. Their subjects also described the rule governed regularity in the orthography.

Baron (1977) states that regularity in the script or the orthographic rules are learned best by observing the similarities in words. Baron (1979) found that the ability to read nonsense words was highly correlated with the ability to read regular words. Also the ability to use specific associations, as in reading exception words, is

more highly related with ability to read regular words than nonsense words. Baron also stated that dyslexics seemed to be deficient more often in rules than in specific associations.

Mason (1975) studied poor and good readers to see the effect of orthographic structure and their abilities to search for letters in different word displays. Poor readers were as good in performance as good readers only on random displays. Only good readers were sensitive to the orthographic rules in identifying letters. Poor readers' difficulties in acquisition and use of orthography has been supported by many studies (Bradley and Bryant, 1979, Schwartz and Doehring, 1977, Singer, 1982).

It is being argued whether phonological rules also influence along with the orthographic rules the recognition and reading of words (Spoehr and Smith, 1975, Taft, 1979). In any case the suggestions held are that training children should incorporate the idea of orthographic rules (Baron, 1977, 1979, Caldwell, et al, 1978, Carr, et al, 1979, Massaro, 1980).

10. Rule Learning.

According to Gagne (1975) rule learning is a widely occurring intellectual skill. "A great deal of learning

within educational programs is concerned with rules. The young child learns rules which enable him to decode words in reading, to spell words, to compose sentences..." (p 61). According to Gibson (1969), children learn to read the invariant units similar to the rules of spoken language. This provides for the economy and efficiency of the information pick up. Brooks (1977) found that rule based learning was faster than paired associate learning. His subjects learned to pronounce six four letter words made of six artificial letters. In another condition the six printed words were randomly paired with the six spoken words so that the orthography was no longer useful. Even after 500 trials with each stimulus subjects could pronounce the words faster in the condition with orthographic learning than the association learning.

Morrison (1984) observed that disabled readers experienced difficulty in learning associations that are governed by rules, particularly if those rules contained exceptions or inconsistencies. He found that disabled readers take more time to read inconsistent words. Also in an association learning task, when artificial symbols were paired with words, disabled readers performed poorly on rule governed associations and were poorest where they had to learn by inconsistent rules. It is suggested that possibly the poor readers had tried to learn on wholistic basis than looking for the invariant rules of the task

(Vellutino and Scanlon, 1984).

Caldwell, et al. (1978) reviewing the phonic rules of English found that rule complexity, apart from the frequency, is a crucial variable in determining its utility. Gagne (1970) stated that even if all the prerequisite rules are known that does not mean that the higher order rule is also immediately known. It has to be learned, If the lower order rules are known the conditions within the learner are satisfied but not the conditions of learning situation. There must be some instruction which includes the step of informing the learner about the form of the performance expected, encouraging recall, and cueing the proper sequence of acts. This is true of a child learning to decode words, particularly when the orthographic rules are applied inconsistently.

11. Summary.

From the foregoing one can note that all the factors described are essential for normal fluent reading. Obviously the factors of syntax and comprehension in reading were not specifically considered as the review was restricted primarily to word reading. It should be noted that development of rules about the internal structure of words, strategies in reading, and automaticity are not only important for skilled decoding of words but are prerequisite to comprehension in

reading which is the goal of learning to read. These factors are not only important for reading acquisition but, as noted, are identified to be hurdles to reading when they do not develop optimally. It is felt that these findings are quite generalizable. Considering that these are important factors it is important to make use of them in testing reading and reading difficulties. According to Shankweiler and Liberman (1972)

> One often encounters the claim that there are many children who can read individual words well yet do not seem able to comprehend connected text. The existence of such children is taken to support the view that methods of instruction that stress spelling to sound correspondences and other aspects of decoding are insufficient and even produce mechanical readers who are expert at decoding but fail to comprehend sentences. It may well be that such children do exist; if so, they merit careful study. Our experience suggest that the problem is rare, and that poor reading of text with little comprehension among beginning readers is usually a consequence of reading words poorly (i.e., with many errors and/or at a slow rate) (p 294).

Thus the first level of evaluating reading should be to rule out the problem in reading at the word level. From this review the following statements can be made. 1) Good readers expend least attention to the constituents of words and thus read them automatically. That is, they will be able to identify the words quickly. 2) Good readers can not only read words fast but also process the components of the words in the given sequence appropriately. That is,

they are good at sequential processing of the reading stimuli. 3) Good readers are also adept at using the rules of orthography. They are also good at using both the consistent and inconsistent rules of orthography in reading. Converse to these the proceeding statements can be made. 4) Poor readers may be slow readers. Given enough time they may be able to read words correctly though slower. 5) They may not be processing the components of wards precisely and in a correct sequence. 6) They may also be poor in learning the orthographic rules and in applying them to reading.

METHODOLOGY

The object of this study was to have a framework for testing Kannada reading based on the factors,rules of orthography,sequential processing, and automaticity. The intention was to see if poor readers and good readers were significantly different in these abilities in reading syllables and words. The proposition was that good readers would read the words automatically and correctly using the rules of orthography and by keeping the sequence of syllables correctly. The other proposition was that poor readers would not read automatically and observe the rules of orthography and the sequence of syllables in reading words. It was also proposed that the sequencing ability of readers as measured by nonverbal tests will be related to reading.

In this study, all the rules of orthography were tested. Kannada uses a large number of explicit rules in the orthography. There are regular and irregular ligaturing rules. All these rules relating to 50 letters were included for testing. The knowledge of the rules of orthography was tested in reading individual syllables and words. With those who failed reading words and syllables the experimenter constructed the syllables from basic letters by adding one ligature at a time. This process was termed interaction

as the experimenter provided the task depending on the appropriateness of the response.

Automaticity in reading was evaluated by children's performance on tasks of reading the stimuli exhibited for a limited time. The ability to read words and syllables at subjects own pace was tested to see whether they had problems with automaticity alone in the processing of words and syllables.

The sequential processing of the components of syllables and words was tested by tasks of reading them correctly. The relation of nonverbal sequencing processing ability to reading was evaluated by correlating children's performance on reading and sequential markers. Similarly the relation of simultaneous processing to reading was evaluated by correlating the performance on simultaneous markers and reading.

Table 1 presents the scheme of testing. Columns 1, 2, 3 and 4 in the table represent the level of the reading task, the number of diacritical visual features, supposed processing needs,and probable difficulties in reading respectively (a diacritical feature is part of a letter which can represent a phoneme).

Table 1

The Scheme of Testing

Reading Level	Diacritical features	Processing needs	Difficulties in reading
1. Word	Syllables	Automatic sequential	Slow reading omitting-syllables misreading (omitting or substituting features)
2. Syllable of the alphabet	1-3	Automatic	Confusion
3. Syllables of'c + v's	2-6	Automatic sequential	Slow reading misreading
4. Syllables of'cc + v's	3-6	—do-	-d-

1. Subjects

Children studying in grade three were the subjects. Children from the Demonstration Model School (Mysore) were selected to be the subjects as the students population is relatively more homogeneous in terms of the socioeconomic levels of their homes. These children had attended atleast 20 months of formal schooling. Children are admitted to schools only at the age of 5 years. Children are promoted to next grade only if they score 35% or more in the annual examinations. Also,the children need to attend the school atleast for a particular number of days in order to be promoted (75% of working days). Thus the subjects were those children who had scored a minimum of atleast a 35% in earlier grade and had attended the formal teaching for the prescribed time. The average age of subjects was 8 years and their age range was seven to nine years.

Only new comers to grade three were considered for selection. Children who were retained in grade three and not promoted to grade four were omitted from selection. Children in grade three were chosen because they were expected to have mastered the basic skills of reading and be adept at reading the print. They were also expected to read the books of content like literature, social studies, and science. The fact that there were three books of

various contents for the third grade (and only single text book for the earlier grades) justifies the assumption that these children were expected to be fluent in reading the print and could absorb the content of the prescribed texts.

The class teachers of grade three were asked to rank order the children depending on their achievement. The teachers routinely evaluate the achievement of the class every month using written tests in various subjects. There were 96 children in the two sections of the class. From the rank list the teachers provided names of the highest achieving 10% and the lowest achieving 10% of the children were chosen. The chosen children were screened using a developmental screening test standardized in India (Bharatraj, 1983). Only the children passing in this test were considered for being subjects. If a subject failed this test the next child in the achievement rank was screened for selection. None of the high achieving children failed the test and only one of the poor achieving children failed in this test for which the next child was screened. The selected children were without apparent sensory motor handicaps. They were also checked for apparent speech and hearing difficulties by a speech pathologist and audiologlst.

There were 20 subjects, half of them were poor achievers and the other half were high achievers, constituting two groups. The class teachers rated the poor and high achievers as also

poor and good readers respectively. These groups will be referred to as poor and good reading groups here onwards. The sample was incidental and the subjects were not chosen on any other basis like gender. There were seven boys and three girls in poor reading group and four boys and six girls in good reading group.

Two groups, high achieving and poor achieving, were selected because the intent of the study was to see if they differed significantly an the factors chosen. Only 10% of the population was selected as a large number of subjects from the class would dilute the abilities or the inabilities of the group. It is known that about 10% of children reading phonetically regular scripts have reading difficulties (Aaron, 1979). Also, selection of subjects was limited to only one school because this school follows a particular curriculum and is consistent in doing so as the school is run by a research organization.

2. Materials

The materials for testing reading were the prepared lists of words and syllables. The lists consisted of 118 words and 136 syllables. Standardized tests were used for evaluating sequential and simultaneous processing strategies. The following reading test materials described are presented in the same order in Appendix A.

1. List for word reading:

This list has words of alphabet letters, words with consonants ligatured with different vowels, words with blends of two and three consonants, and words with alternate forms of writing. The words have regular and irregular ligaturing rules as described in the first chapter. There are 118 words in the list. Fluent reading of all words in the list requires children to be adept with all the rules of orthography. Care was taken to see that the words are not of rare occurence or the very first words which the children might have overlearned.

2. List of syllables in the alphabet:

There are 50 items in this list. These are the letters of the alphabet shown in Figure 1 in the first chapter. Bach letter either represents a vowel or a consonant with the vowel [a].

3. List of syllables having consonants with various vowels

There are 24 items in this list. The syllables consist of all the vowels ligatured with different consonants. Care is taken to include all the regular and irregular forms of occurence of ligaturing vowels described in the first chapter.

4. List of syllables with consonant blends:

There are 47 items in the list. The list includes syllables of geminated and blended consonants. The list incorporates the regularly represented consonant features as well as irregularly represented ones. These are also shown in Figure 3 in Chapter I.

5. List of syllables with blends of three consonants:

There are five items in the list. These blends usually occur in Kannada.

6. List of syllables with alternate forms;

There are eight items in the list. This list contains both forms of writing of certain syllables. Either of these forms may be used in print.

Words in the first list include all the rules of orthography that the later five lists of syllables have incorporated.

It is known that reading letters is facilitated when they are in words (McClelland and Rumelhart, 1981). While each word could help processing the constituted syllables by providing context, letters in isolation could be read only with the knowledge of the rules of orthography.

The following were the tests for the simultaneous and sequential processing strategies that were used for solving the respective tasks. Das and Cummins (1982) have termed these tests the processing markers as they are used to identify the processing strategies.

1. Memory for Designs; (Graham and Kendall, 1960)

The test material consists of 15 designs. All designs are composed of straight lines. The test involves the presentation of the geometric designs and reproduction of designs from immediate memory.

2. Colored Progressive Matrices: (Raven, 1965)

The material consists of three sets and there are 12 problems in a set. In each problem there are six figures from which a selection has to be made or chosen. The test is generally used as a marker of simultaneous processing.

3. Visual Sequential Memory: (Kirk, McCarthy, and Kirk (1968)

The test has 25 sequence items. The test assesses the subjects' ability to reproduce sequences of non meaningful figures from memory. The subjects are shown each sequence of figures for five seconds and then asked to put corresponding chips of figures in the same order.

4. Auditory Sequential Memory:(Kirk, McCarthy,Kirk, 1968)

There are 28 digit sequence items in this test. This test assesses the subjects' ability to reproduce from memory sequences of digits increasing in length from two to eight digits.

3. Procedure

The following was the order in which the tests were administered.

a. Raven's Progressive Matrices, Auditory Sequential Memory, Visual Sequential Memory and Memory for Designs.

b. Reading words (list 1) one at a time with brief exposures.

C. Reading syllables one at a time with brief exposures (from one of the lists 3, 4, 5, and 6, one at a time).

d. Reading words consisting of similar syllables (which were misread earlier) with no time limit of exposure.

e. Reading the syllables (which were misread earlier) with no time limit of exposure.

f. Reading letters of the alphabet (list 2) one at a time with brief exposures.

g. Reading words made of letters (which were misread earlier) with no time limit of exposure.

h. Reading letters of the alphabet (which were misread earlier) with no time limit of exposure.

i. Interaction with the child in constructing the syllables.

The order of testing was retained across subjects as the order provided a check against any possible practice effect. Words were presented first and then the syllables and alphabet letters at the end to avoid the practice effect. The words and syllables as presented in the appendix are in Kannada alphabetical order. While testing, the items in each list were randomly ordered to remove the influence of the alphabetical order.

The children were quite inquisitive about the tests for sequential and simultaneous strategies. These tests also kept the children interested in new tasks. The tests Progressive Matrices, Auditory Sequential Memory, Visual Sequential Memory, and Memory for Designs were administered and scored as required by the respective standardized

procedures.

The children were tested on the nonreading tests in the first session and their reading was tested in the second session. Each reading stimulus was printed on 7 cm X 13 cm ivory cards. These cards could be used as flashcards. Every subject was instructed as follows, in Kannada, before the reading materials were exhibited. "This is going to be a reading game, unlike the ones you had earlier. There are words or letters written on these cards. You are required to tell me what is written as soon as I show it to you. I am going to show the writing for a very short while. Let us see how fast you can read them." The subject was asked if she/he was ready for the task and on consent the stimuli were introduced. Each stimulus card was exhibited on the table in front of the child to be read. The stimulus card was quickly covered by an empty card. It used to take approximately one half a second to cover the stimulus card. The experimenter had practised placing the cards to keep precision. The response to the stimulus was recorded on paper in Kannada script.

The reading stimuli were exposed for only half seconds in the brief exposures. The purpose of brief exposures was to test the automaticity in reading of syllables and words. The reason for selecting one half second criteria was that in reaction time studies, the time the subjects

needed to read single letters was 500 milliseconds. Reading words could even be faster than identifying single letters. Also when tried with children half second criteria was found appropriate for reading a stimulus. All good readers, for example, could recognize the stimuli in the given time of exposure. Both words and syllables were exposed for one half seconds each and the responses were recorded.

The children read the stimuli both at brief and long exposures. The children went through reading the list 1 at brief exposures in the beginning. Whenever there were mis-readings the stimulus cards were categorized to be read later at long exposures. Next the children went through the list 3, reading the syllables with various vowel ligatures. The stimulus cards were read at brief exposures. When the misreadings occured the stimulus cards were kept separate to be read later at long exposures. At this juncture, the earlier misread words having similar syllables as in list 3 were presented to be read at long exposures. After the said words were read at long exposures the misread syllables from list 3 were presented to be read at long exposures. After every exposure the response was recorded. If the children had misread the syllables even after long exposures the experimenter constructed the syllables step by step by adding one ligature at a time. At each step the child was encouraged to read the syllable and was helped to

read by providing cues. After the list 3, the procedure, including the interaction task, was repeated for lists 4, 5, 6, and 2.

Following is an example of an interaction. In the beginning experimenter wrote an alphabet letter and asked the child to read it. Later the letter was modified in each step after the child's response.

1.  [sha] "What is this letter?"
   The child responds.

2.  [shu] "What does it become now?"
   The child responds.

3.  [shtu] "How do you say it now?"
   The child responds.

4.  [shtru] "And now?"
   The child responds.

This procedure could help in learning whether the child was aware of the rules of orthography and also about the subject's ability to make use of the rules which were presented in the immediate past.

RESULTS AND DISCUSSION

1. Results.

The intent of the study was to see whether poor readers were significantly different from good readers on the measures of automaticity, knowledge of orthography, and sequential processing abilities. The results obtained, to be discussed later, have provided adequate support for differentiation of poor readers from good readers on the bases of automaticity and the knowledge of the rules of orthography.

The data consisted of the scores obtained on the following measures.

1. Reading words following brief exposures. The stimuli word lists included words of alphabet letters and words incorporating various rules of orthography. These categories of words have been analyzed separately.
2. Reading words exposed without the time limit.
3. Reading syllables following brief exposures. Syllables included the letters of the alphabet and syllables with various rules of orthography.
4. Reading syllables exposed without the time limit.
5. Auditory sequential memory.

6. Visual Sequential Memory

7. Raven's Progressive Matrices

8. Memory for Designs

Correct reading of each stimulus exposed was scored one and any misreading was scored zero. A score of one was given whenever the child correctly read the stimulus following either brief exposure or long exposure. The same stimuli were provided for reading at long exposures when they were misread at brief exposures. Thus the scores of corrected and non-corrected reading of stimuli were available.

The responses to list 1 were split into two groups for analysis, words of alphabet letters and words with various rules of orthography. The responses to list 2, i.e., letters of the alphabet, were considered as a separate measure for analysis. The responses to the lists 3, 4, 5, and 6 which incorporated various rules of ligaturing were grouped under rules of orthography for analysis. Further, each group of these stimuli has been considered for analysis independently. The scores on brief exposures inform about the automatic processing, whereas the readings under long exposures and interaction tasks reveal the knowledge of orthography. The misreadings were noted and quantified for each list of stimuli. The sequencing difficulties and the orientation misreadings have been noted. The scores under

each category, i.e., alphabet letters, words of alphabet letters, syllables with various rules of orthography, and words with various rules of orthography were large anough to be compared between groups. The raw scores have been tabulated in Appendix B for reference.

To look into the overall difference between the groups and among the different stimuli,a two way analysis of variance, with repeated measures on one factor, was carried out (Winer, 1971). Factor A was the ability of the groups and factor B was the different reading stimuli. The result is shown in Table 2. The difference between groups were found to be significant ($F = 5.75 > 4.41$, significant at .05 level). Reading of the various stimuli were differently achieved by the entire subject population. There were significant differences in the achievement ($F = 50 > 4.16$, significant at .01 level). It was noted that good readers were superior in reading in terms of automaticity. Poor readers achieved less quantitatively in reading the various stimuli. There was no considerable interaction of the factor automaticity and the ability of the groups as can be seen in Figure 6.

The intent of the study was to find if there were significant differences between good readers and poor readers on various measures and their extent. The differences between good and poor readers on automatic and

Table 2

Source Table of Analysis of Variance

Source	df	Ms	F
A (Good and Poor)	1	938	5.75*
Subjects within	18	163	
B (Kind of stimuli)	3	1751	50.00**
A x B	3	35	2.43
B x Subjects within	54	35	

*Significant at 0.05 level
**Significant at 0.01 level

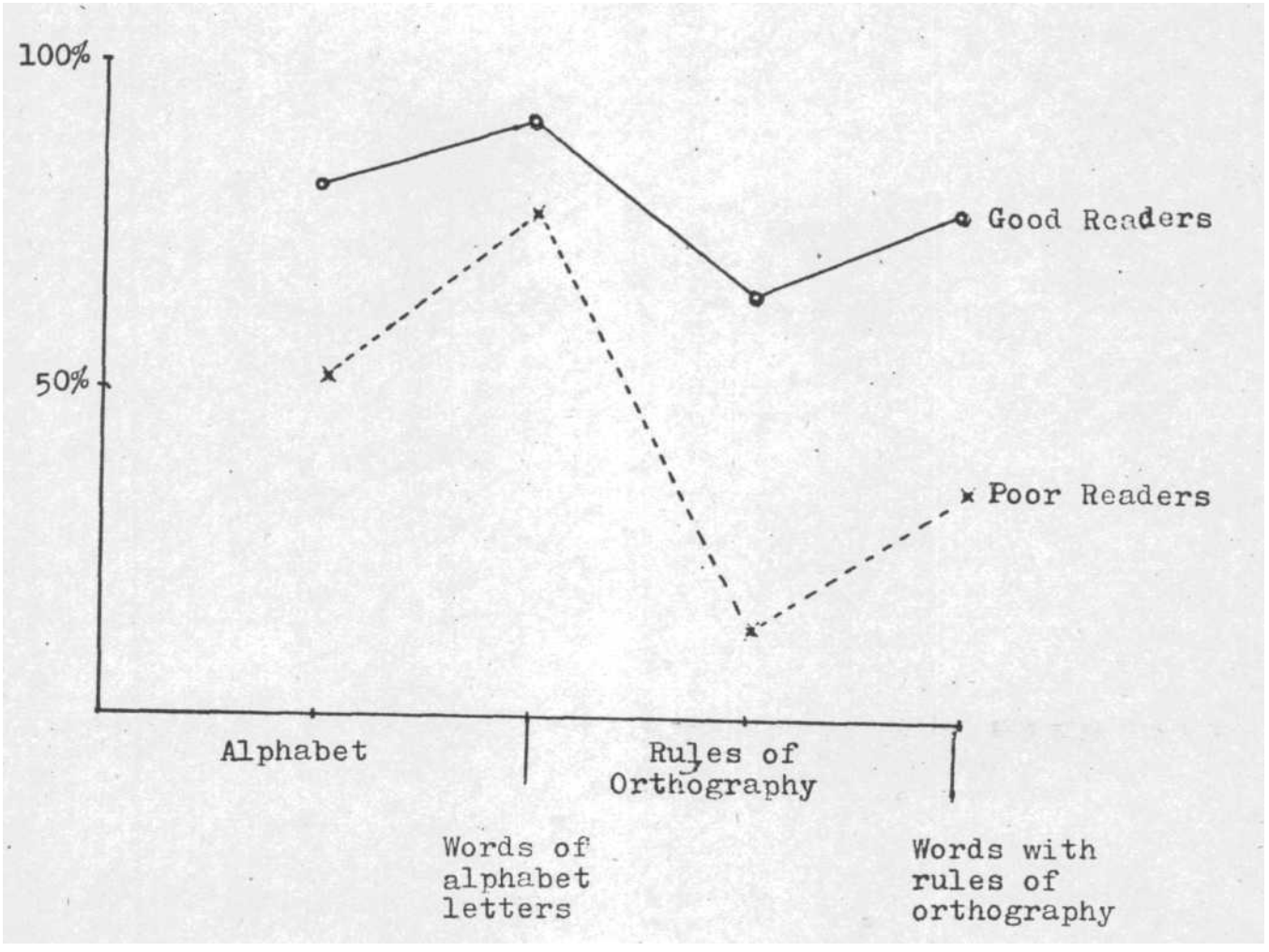


Fig. 6 The differences between good and poor readers on the various measures of reading.

correct reading were found by using the t-tests (Johnson and Liebert 1977). The good reading children in the task of reading words following brief exposures, were found to score significantly high. Similarly, they also scored better on reading the letters of the alphabet and the syllables with rules of orthography. Table 3 provides the mean scores and the t-scores indicating the significance of differences.

In the analysis of relationship between reading of words and the knowledge of the rules of orthography, alphabet letters, words of alphabet letters, syllables with rules of orthography, and words with different rules of orthography were considered. The product moment correlation co-efficients among them are given in Table 4. There was a high correlation of the knowledge of alphabet with words of the alphabet letters and with syllables incorporating various rules of orthography. Similarly a high relationship was observed between the reading of the syllables with rules of orthography and words having such syllables. Whereas the good readers had a high relation between the knowledge of orthography and reading words, the relationship of these was not high among the poor readers.

To rule out the factor automaticity and to learn about the relation of reading words to orthographic knowledge, among good and poor readers, the following analyses were

Table 3

Significance of differences between good and poor readers on various reading measures following brief exposures

Measure	Mean correct scores		t-scores
	Good readers	Poor readers	
Letters of alphabet	46	39	4.01**
Words of alphabet letters	37	24	4.36**
Rules of orthography	58	26	6.25**
Words with orthographic rules	38	8	8.20**

**Significant at 0.001 level

Table 4

Correlation Matrix for various measures of reading following brief exposures

	Alphabet letters	Words of alphabet letters	Ortho-graphic rules	Words with orthographic rules
Alphabet letters	.	.63 .57	.62 .57	
Orthographic rules				.75 .62

Note: Upper row coefficients are of good readers and coefficients in the lower rows are of poor readers.

done. For these analyses the scores on reading the stimuli at long exposures were considered. Correlation between reading letters of the alphabet and words made of them, as well as correlation between reading syllables with rules of orthography and words having such syllables were found. The correlation coefficients are provided in Table 5. It was seen that reading words was highly correlated with reading syllables among good readers. Such relation was not found among poor readers.

The difference between good and poor readers on reading syllables and words was found using t-tests. The results are given in Table 6. Both the good and poor readers correctly read the stimuli at long exposures, which were earlier misread at brief exposures. Both groups corrected almost equal number of words. But the poor readers corrected more of the simple material (alphabet lettered words) compared to the good readers. Though poor readers seemed to have corrected more items than the good readers, they had only corrected a small part of what was misread compared to good readers (see Appendix B). On the other hand, good readers had been consistent and better in making use of the unlimited time of exposure in reading.

Kannada has a phonetically regular syllabic script following a number of orthographic rules. The difference

Table 5

Correlation coefficients among the various reading measures following long exposures

Measures	Good readers	Poor readers
Alphabet letters, Words of alphabet letters	.49	-.03
Orthographic rules, Words using orthographic rules	.54	.1

Table 6

The differences between good and poor readers on reading various stimuli following long exposures

Measures	Mean correct responses		t–scores
	Good readers	Poor readers	
Alphabet letters	2	4	2.77**
Words of alphabet letters	8	11	1.76
Orthographic rules	10	13	0.96
Words with orthographic rules	14	11	1.1

**Significant at 0.01 level

between groups in being able to correct and not able to correct the misread stimuli when ample time for reading was permitted provides a measure of the knowledge of the rules of orthography. The differences between the corrected and uncorrected stimuli for each group was calculated. Table 7 provides the t-scores for these differences. The description of the table is as follows. The poor readers had left more alphabet letters uncorrected than corrected. However this difference did not reach significance. In reading words of alphabet letters as well as words with rules of orthography good readers corrected a significant number of them. On the other hand, poor readers had left most of the syllables with various rules of orthography and words with such syllables uncorrected. It was only in reading the words of alphabet letters that poor readers had corrected almost equal number of words as were left uncorrected. That is to say that only good readers corrected most of the misread stimuli making use of long exposures.

When the subjects failed reading the syllables even after the long exposures,the experimenter interacted with the subject in constructing the syllables. The poor readers confused the letters, generally with those which look similar. Whenever the construction of syllables was complex, involving more than two written features, the poor readers could not follow the construction. Whereas good readers could make

Table 7

The differences between the number of corrected and uncorrected readings following long exposures

	Alphabet letters	Words of alphabet letters	Ortho-graphic rules	Words using orthographic rules
Good readers	.36	11.19**	.88	2.86**
Poor readers	1.82	.33	5.15**	6.61**

**t-scores significant at 0.01 level

use of the examples of similar syllable constructions, the poor readers could not use the cues and continued to misread the syllables. There used to be less number of syllables left to be constructed with good readers compared to poor readers.

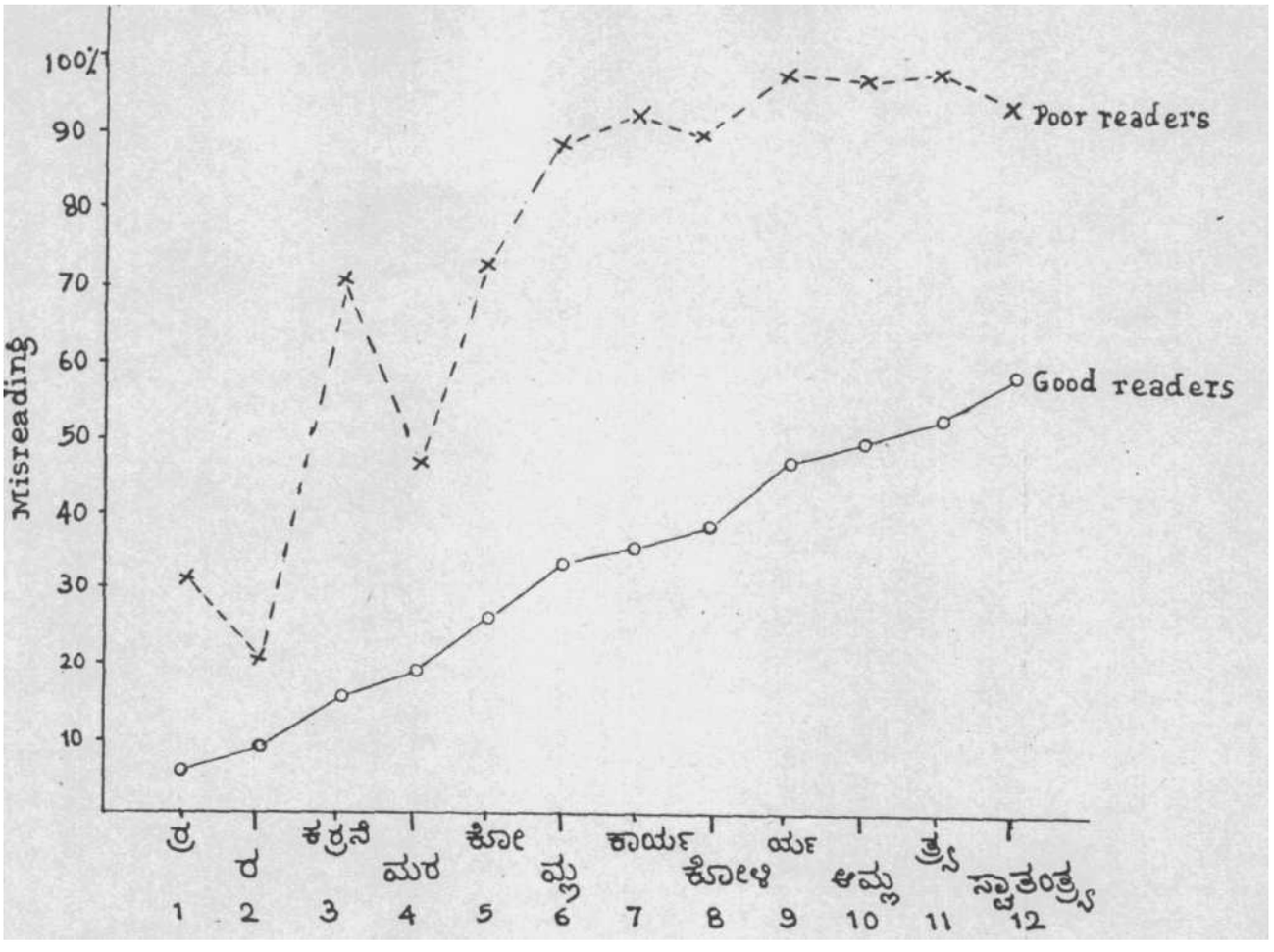
Misreadings have occurred in all measures of reading and both groups of readers have misread. But the extent of misreadings were found more among the poor readers as expected. These misreadings have been largely due to confusions among letters and in the orthographic patterns as expected. Table 8 presents the number of misreadings in both groups. This table also includes the misreadings due to sequential processing difficulties in syllables and words.

The extent of misreadings have been graphically shown in Pigure 7. It is of interest to note that as the complexity of the reading material increases the number of misreadings also increase. It is clear that the poor readers have significantly misread the material. Whereas the proportion of misreadings among good readers increase in accordance with the number of discritical features and the phonemic complexity, it was not true for poor readers. Poor readers had performed well only on the simple material (alphabet letters and words of the alphabet letters).

Table 8

The number of misreadings observed in good and poor readers

Measures	Total No. of items for each group	Good readers	Poor readers
Alphabet letters	500	39	103
Words of alphabet letters	460	86	210
CV syllables	240	62	173
Words of CV syllables	150	57	135
Geminated CCV syllables	270	14	82
Words of CCV syllables	200	31	140
CCV blend syllables	200	65	177
Words of CCV syllables	200	98	195
CCCV syllables	50	26	49
Words of CCCV syllables	50	29	47
Syllables of alternate spellings	80	37	79
Words of alternate spellings	120	42	111
Sequencing difficulties			
Words reversed		3	4
Letters and ligatures reversed		10	19



Stimuli

1. Geminated CCV syllables. 2. Alphabet letters. 3. Words with CCV syllables. 4. Words with alphabet letters. 5. Syllables with various vowels. 6. Blend CCV syllables. 7. Words with syllables of alternate spelling. 8. Words of syllables with various vowels. 9. Syllables with alternate spellings. 10. Words with syllables of CCV blends. 11. CCCV blends. 12. Words with CCCV syllables.

Figure 7. Misreadings of various reading stimuli by the poor and good readers.

Some instances of sequencing problems were observed in both good readers and poor readers. Transposition of syllables or letters in reading words, i.e., difficulties in keeping the syllable sequence, were observed. Misreadings due to rotation or orientation difficulties of letters were also observed. Both kinds of difficulties have been referred to as reversals in the literature. It was surprising to observe these in Kannada reading.

Sequencing difficulties, i.e., transpositions of letters were observed in reading of words. These were observed, in both groups of readers, and were few in number (see Table 8). Usually these difficulties were observed in words of two or three letters. These sequencing difficulties were also associated with misreadings and occurred in simple words wherein the ligatures were few. These readings were also meaningful words, though not as a rule. Sometimes there were nonmeaningful sequences read from words. Table 9 presents some of the sequencing difficulties observed.

Sequencing difficulties within syllables were also observed. But there were only few of them. These syllables that were parts of different words when misread did not always bring about meaningful words. Some of these sequencing difficulties in syllable reading are presented in Table 10.

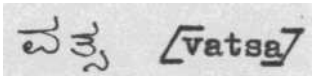
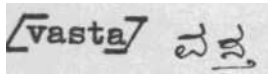
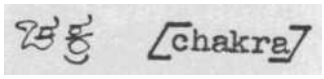
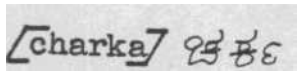
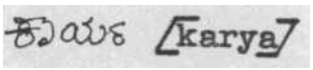
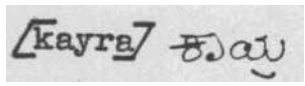
Table 9

Reversals in reading Kannada words

ಜಯ /jaya/	read as	/yaja/ ಯಜ	
[victory)		(not meaningful)	
ಲವ /Lava/	read as	/mala/ ಮಲ	
(a name)		(stools]	
ಗಂಧ /gandha/	read as	/ranga/ ರಂಗ	
(fragrance)		(stage)	
ರಮಣ /ramana/	read as	/marana/ ಮರಣ	
(husband)		(death)	
ಡಬ್ಬ /dabba/	read as	/bada/ ಬಡ	
(box)		(poor)	
ಶಬ್ದ /shabda/	read as	/besha/ ಬೆಶ	
(sound)		(not meaningful)	

Table 10

Reversals in reading Kannada syllables

 [vatsa]	read as	[vasta] 	
(mister)		(not meaningful)	
 [chakra]	read as	[charka] 	
(wheel)		(spinning wheel)	
 [karya]	read as	[kayra] 	
(Work)		(not meaningful)	

Orientation reversals in reading Kannada letters and ligatures was a surprising finding. However, there are not many letters in Kannada alphabet which look like others, when rotated or in the mirror images. Only letters (ta)  and (na)  are exceptions, that is, they can be mistaken to one another when rotated 180 degrees. Also there are some allographs which can be mistaken to letters. Some of the reversals in the reading of these are given in Table 11. It should be noted that sequencing problems were less in number and occurred in the reading of both the good and poor readers.

It had been proposed that there will be a relation between the reading and the sequential and simultaneous processing strategies. It was expected that in the instances of processing more than one unit of print the reading will be related to sequential processing ability. Similarly, automatic processing in reading was expected to be related to simultaneous processing ability.

It should be recalled that the sequential difficulties observed were meager. Tables 12 and 13 provide the correlation coefficients for various reading measures and the sequential and simultaneous processing strategies. In reading syllables of various orthographic rules and different words the sequential processing would have been needed. A positive correlation has been found for reading

Table 11

Orientation Reversals in reading Kannada

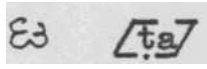
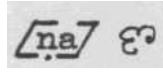
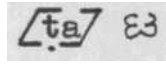
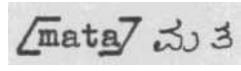
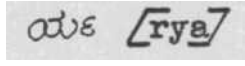
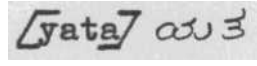
	read as	
	read as	
	read as	
	read as	

Table 12

Correlation coefficients for reading measures and sequential processing strategy

Processing marker	Alphabet letters	Words of alphabet letters	Ortho-graphic rules	Words with orthographic rules
Auditory Sequential Memory		.14	.31	.1
		.45	-.46	.0
Visual Sequential Memory		-.38	-.15	.05
		.35	-.14	.12

Note: Correlation coefficients in the top row are of good readers and in the bottom row are of poor readers.

Table 13

Correlation coefficients for reading measures and simultaneous processing strategy

Processing marker	Alphabet letters	Words of alphabet letters	Ortho-graphic rules	Words with orthographic rules
Raven's Progressive Matrices	-.06	.11	.25	.34
	.24	.08	.1	.0
Memory for Designs	.01	.29	.01	.24
	-.49	-.5	-.67	-.16

Note: Correlation coefficients in the top row are of good readers and in the bottom row are of poor readers.

complex syllables and sequential processing on the test Auditory Sequential Memory for good readers (r = .31). For good readers there was not any considerable relationship observed in reading words and sequential processing strategy. A considerable positive relation has been seen between reading simple words and sequential strategy among poor readers (r = .45 and .35).

An increasing relationship with the increasing of complexity of reading material was seen when the measures on Raven's Progressive Matrices were correlated with different reading measures for good readers. For poor readers a reverse pattern was seen. A high relationship was observed between reading of simple material and simultaneous strategy. A trend was also seen that simultaneous ability as measured by progressive matrices was related to reading of words among good readers and reading of syllables among poor readers.

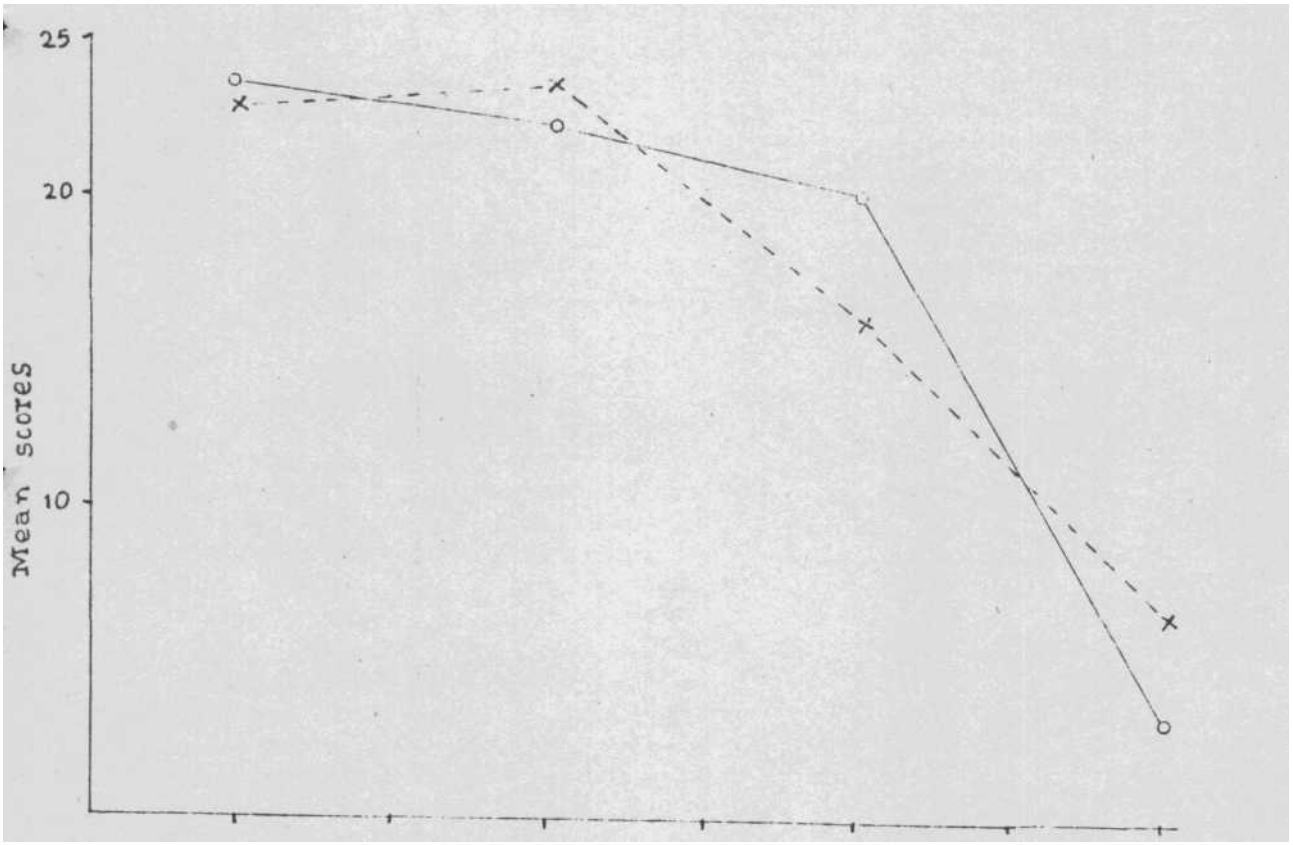
The scores on Memory for Designs were actually scores of nonachievement, i.e., a child normally copying designs would score nil, but a design not well copied would be awarded with high scores depending on the extent of deviation. Thus a low correlation coefficient could be expected even when there was actually a positive correlation. In Table 13 the coefficients of correlation on the test Memory for Designs indicate that a relation

exists between the reading of syllables and simultaneous processing in both the groups. The relationship of simultaneous processing to word reading was not as high as that of syllables.

Reading words among poor readers seem to be related to their sequential processing abilities. Their abilities in reading syllables (single letters) seem to be related to their simultaneous processing abilities.

It should be noted that the performance of good and poor readers on the sequential and simultaneous strategies of processing are comparable (Figure 8). However, the differences noted between groups on their relations to reading will also be considered for discussion even though they were not extensive.

In the light of the above results the hypotheses proposed for the study have largely stood the test. The first hypothesis that 'Good readers will read words and syllables correctly and automatically' was supported by the finding that the good readers consistently scored significantly better than the poor readers on all measures (Figure 6, Tables 2 and 3). The first subhypothesis that 'Good readers will use all the rules of orthography compared to poor readers' also stands accepted as the good readers had performed better in all reading situations where



	Auditory Sequential Memory	Visual Sequential Memory	Raven's Progressive Matrices	Memory for Designs
Good Readers				
Mean	23.4	22.3	20.1	3.4
SD	6.37	3.13	6.26	2.46
Poor Readers				
Mean	22.7	23.3	16.0	6.7
SD	10.9	5.03	4.29	3.71

Figure 8. Performance of subjects on the proccessing strategy Markers.

orthographic knowledge was required (Figure 6, Tables 3, 4, 5, 6, 7, and 8). The second subhypothesis was partially supported. The statement that 'Good readers will read the components of words in the right sequence' could be accepted as there were a few number of sequencing difficulties noticed in the reading of good readers. The latter part of the subhypothesis that 'Reading the components of the words in the right sequence will be related to their sequential processing of nonreading stimuli' was not adequately supported to be accepted. The good readers processed the reading stimuli in the right sequence, however, this is not a comparative statement.

The second major hypothesis that 'Poor readers will not read words and syllables correctly and automatically' was accepted. It was supported by the consistent findings that poor readers scored significantly less in all the measures of reading (Tables 3, 5, 7, and 8). The sub-hypothesis that 'Poor readers will read correctly, when allowed longer time compared to good readers' though seemed supported, the support was spurious. The poor readers had read significantly more number of stimuli at long exposures only in the reading of alphabet letters (Table 6) whereas they had actually left a significant number of the stimuli uncorrected (Table 7). In this regard, the good readers had made use of the long exposures more efficiently than

poor readers. Thus the subhypothesis was not accepted.

The second subhypothesis that 'Poor readers will not use all the rules of orthography as good readers do. They will not use the complex and irregular rules' stands accepted. The poor readers scored the lowest in the knowledge of the rules of orthography. They scored always less whenever the reading task required the knowledge of orthography (Figure 6, Tables 3, 4, 5, 7, and 8). It was observed during the interaction that poor readers were not able to follow the construction of complex and irregular syllables.

The last subhypothesis that 'Poor readers will not read the components of words in the right sequence' was not accepted. In sequential reading of the stimuli the poor readers' problem was not considerable. Their difficulties in sequencing were comparable to those of good readers (Table 8). The latter part of the subhypothesis that 'Reading the components of the words in the right sequence will be related to their sequential processing of nonreading stimuli' was partially supported. Sequential processing on nonreading tests was observed to be positively related to the reading of simple words. However, it should be noted that the major reading difficulties in both the groups were not because of the sequencing difficulties.

2. Discussion.

The findings of the study supported the proposal that good readers and poor readers in Kannada can be usefully differentiated based on the measures in automaticity and orthography in reading. The idea that the cognitive nonverbal processing strategies will be related to sequential reading and automatic reading of the readers was partially supported.

Automaticity in reading was observed to be well developed among good readers in comparison to poor readers. Good readers could read significantly more syllables as well as words at brief exposures (Figure 6, Table 3). The good readers had learned well to read these stimuli automatically without deploying much attention. Though it is held that automaticity develops sooner after beginning reading, only good readers were found to be better automatic readers (Guttentag, and Haith, 1978, Stanovich, et al, 1981). Poor readers were probably still attending to the details of print to decode the stimuli and yet to become adept in reading invariant units of print (LaBerge and Samuels, 1974, Gibson, 1969).

The finding that the poor readers could correctly read a large number of syllables when allowed to read at their own pace supports the idea that inadequate development of

automaticity was a factor contributing to their reading difficulties (Table 6). Speed of stimuli recognition in reading has been found to be a factor contributing to reading achievement (Chabot, et al, 1984, Durkin, 1980, Lesgold and Curtis, 1981, Perfetti and Roth, 1981). It was found that orthography highly contributed to reading ability. It is plausible that the poor readers could have read correctly and automatically if they had acquired the invariants of orthography. Accepting that the knowledge of orthography plays a significant role in the establishment of reading it can be stated that behaviorally the poor readers are slow in the decoding of the reading stimuli.

It was expected that the subjects who had two years of formal learning experience in the classroom will become automatic decoders (Condry, et al, 1979). The subjects could have normally learned the details of print and been fluent in decoding (Chall, 1983, Fries, 1963). The observations are supportive of the idea that good readers are fluent decoders and the converse that the poor readers are slow in decoding the reading material.

It is possible to speculate that it is the knowledge of the rules of writing/invariants of print that may be primarily responsible for the development of automaticity. It was seen that it was poor readers' knowledge of syllables that had contributed to their automatic reading of words,

which is comparable to that of good readers (Table 4). But, on reading following long exposures, only good readers showed a high relation between reading syllables and words (Table 5). It can be surmised that it is the knowledge of the rules of orthography, apart from other possible factors like practice, that permits the development of automaticity among good readers. Similarly, it is the lack of good knowledge of orthography that affects the performance of poor readers both in reading following long exposures and in the development of automaticity.

As children develop automaticity in reading, i.e., learn to process the stimuli parallely, with deploying least attention to the details, they become good readers. It was expected that children's automaticity in reading relates to the nonverbal strategy simultaneous processing. Particularly on the measure Progressive Matrices, a trend of relationship between their reading achievement and simultaneous processing, was seen for both groups. Whereas good readers showed a relationship between reading complex material and simultaneous strategy, the poor readers showed a relationship between reading simpler stimuli and the simultaneous processing. For example, whereas good readers seem to be processing complex words, simple words, and complex syllables simultaneously, for the poor readers such processing seems to be restricted to alphabet letters, simple words and complex syllables (Table 13). There was

also a trend observed that for poor readers, reading syllables was related to simultaneous processing. But it was noted that the relations were not strong ones.

Before the children become fluent readers, they need to learn about the details of print and the invariants therein. Kannada children need to learn the alphabet, allographs of all the letters, and forming syllables by using them. The observation was that the good readers had learned to read using those details very well, compared to poor readers. Good readers were not only able to read significantly more number of stimuli, but were also able to make use of lower level abilities (required in reading simple stimuli) for reading complex stimuli.

Good readers read significantly more number of letters of the alphabet at brief exposures (Table 3). However, poor readers did correct a large number of the misread letters at long exposures (Table 6). But still it was the poor readers who had a large number of letters left misread after the long exposures (Table 7). Kannada letters have round envelopes and many of them can be confused to each other based on their forms. It was observed during the interactions that whereas good readers rarely had confusions, poor readers had more confusions among letters. Poor readers were not able to make out the salient features of the letters not only at brief exposures but also following

long exposures. It has been found in English that letter recognition ability determines the ability of word recognition and reading speed (Bouwhuis and Bouma, 1979, Jackson and McClelland, 1979).

Syllabic scripts are thought to be easier scripts for reading acquisition (Menyuk, 1976, Liberman, et al, 1977). This is not true of all languages. It was found that poor readers of this study had considerable difficulties in decoding the syllables and in constructing the syllables. It could be that though Kannada script is syllabic, apart from having similar looking/confusable letters, it follows many ligaturing rules which are often irregular and complex which pose difficulties in reading acquisition.

Knowledge of the rules of orthography was observed to be an important factor differentiating the good readers from the poor readers. There were significant differences between good and poor readers in their achievements. Good readers scored better in reading the syllables composed of different rules of orthography than the poor readers (Figure 6, Table 3). Good readers were able to correct most of their misreadings following long exposures of the reading materials, whereas the poor readers could not owing to their paucity in the knowledge of the rules of orthography. Good readers' ability in using their knowledge of orthography in reading words was also found to

be higher than that of poor readers (Tables 4 and 7). Generally poor readers misread more than the good readers in all measures of reading (Table 8).

Gibson (1969) and Massaro, et al, (1980) found that the skilled readers in English are more apt to perceive the letter strings of English orthography. It was found true among Kannada skilled readers that they perceived the complex syllables better than poor readers. Poor readers' difficulties in learning orthography have been noted in English (Bradley and Bryant, 1979, Schwartz and Doehring, 1977, and Singer, 1982). It was found true of Kannada readers too.

It is necessary to learn the various rules of adding vowel ligatures and consonant ligatures to Kannada letters if one has to read Kannada syllables. These ligaturing rules often are inconsistent. It will not be possible to read a large number of words if the orthographic rules are not known. It is known that it is the orthographic learning than the association learning that makes the reading efficient (Brooks, 1977). Unlike in English, Kannada children are explicitly taught of orthographic rules in forming the syllables. According to this study the good readers had learned the orthographic rules, whereas with the same teaching exposure the poor readers had not learned those rules. Morrison (1984) had observed that disabled

readers experienced difficulty in learning associations that are governed by rules, particularly if those rules contained exceptions or inconsistencies. It was the inability of poor readers in acquiring rules that had affected their reading. According to Baron, even when the rules are not taught, the orthographic rules are learned by observing similarities in words (Baron, 1977). Probably, in addition, such a learning might also not be happening among the poor readers.

It is possible that when not all the instances of forming syllables are taught in the classroom, the readers may find it difficult to construct certain complex syllables. According to Gagne (1970), even when the lower order rules are learned, the higher order rules may not also be immediately known the complex rules may have to be taught. It was observed that even good readers had certain difficulties in reading complex blend syllables (Table 8). However, it is the poor readers who had scored consistently less in all the measures of orthography including the identitication of letters (Tables 3, 4, 5, 7, and 8).

These findings support the idea that poor readers have difficulties in learning the rule-based graphophonic associations. Also, as the complexity of syllables increases the difficulties in reading increase proportionately. In this regard the poor readers are worse affected. Except

the simple reading material like letters of the alphabet and words made of them, they find most of the orthographic rules difficult to handle (Figure 7).

It has been noted since a long time that reading difficulties in English are associated with sequential difficulties (Johnson and Myklebust, 1967, Orton, 1937). Reading Kannada syllables (except the letters of the alphabet) and words need processing of more units than one. It is imperative that the units are followed in the right sequence for correct reading. The sequencing difficulties and reversals observed in reading Kannada were meager in number (Table 8). The good reading group had such difficulties only in reading 0.05% of the stimuli (13 out of 2520 stimuli) and also the poor readers had such difficulties only in 0.02% of the stimuli (23 out of 2520).

Transposition of Kannada syllables are possible only when the words are of simple syllables like alphabet letters (Table 9). The English alphabet being phonemic, sequencing difficulties have been found higher in number compared to Kannada. Shankweiler and Liberman (1972) reported 15% of the total errors as sequencing errors. Kannada letters, which generally occur with various ligatures, rarely form words without ligatures thus reducing chances for transposition of syllables. Transposing the ligatured syllables in words may render the words

nonpronounciable. Thus the number of transpositions seen are very less among Kannada readers compared to English poor readers. Kannada orthography thus provides immunity for transpositions of syllables within the words. When the reversals do occur the words thus formed may be meaningful or at the least will be pronounciable. Transpositions of syllables seem to be visual in nature. The transposed syllables were not related linguistically.

Kannada script being syllabic transpositions within syllables need separate discussion. In syllables of consonants and vowels there can be no transpositions as always the syllables end in vowels. There can be transpositions in syllables with two consonants and a vowel. The consonants can be reversed. These are unlike the palindromes in English. The examples are given in Table 10. The reversed syllables may bring about a change in meaning of the word and sometimes produce nonsense but pronounciable sequences. Similar to the observation of Shankweiler and Liberman (1972), it was found that the reversals were quite inconsistent. In Kannada, generally the allograph of a consonant is infixed in a CV syllable to form a blend. For example, ' ು' /r/ allograph with 'ಕ' /ka/ is pronounced 'ಕ್ರ' /kra/. As an exception, an other allograph 'ಽ' /r/ with 'ಯ' /ya/, i.e., 'ಯಽ' is pronounced /rya/ which is not infixed but prefixed auditorily

and suffixed visually. In both these instances the transpositions have been observed which rule out the consistency in misreading.

Few orientation reversals were observed in the reading of both the good and poor readers. Reversals of only two letters were observed, 'ಟ' /ṭa/ and 'ಣ' /ṇa/. They were confused for each other. The basis for their misreading can be visual as well as auditory. The letters are not only visually reversible but also their sounds are related phonemically.

In one instance the problem was not only of the reversal but also was associated with the verbal retrieval. The sign 'ಽ' written below the level of letters presents the allograph of [m] and the same next to letters represents the allograph of [r]. In decoding the syllable 'ರ್ಮ' [rma] the response was 'ಮತ'[mata]. The allograph 'ಽ' [m] should have been infixed to 'ರ'[ra] But the subject who had failed to recall the syllable 'ರ'[ra] had recalled 'ಽ' [m] correctly and also reversed its visual form to decode again 'ಽ' as 'ತ' ,[ta]. It could have been 'ರತ' [rata] if there was only the misreading of 'ಕ'[ma] as has happened in a latter instance.

These examples support the finding that the reversals are very inconsistent. It was suggested from the findings

by Shankweiler and Liberman (1972) that visual reversibility is not a sufficient condition for the misreadings and that there may be a linguistic basis. From these few examples seen it may be noted that the bases for the reversals could be both. Whereas the reversals can be dependent on the basis of related sounds ('ந' [na] and 'ட'[ta]) they can also be based on visual characteristics ('ம' [m] and 'ப' [ta]).

The sequencing difficulties observed were not only inconsistent but were also not significant enough to disrupt reading primarily. The findings of Doehring, Trites, Patel, and Fiedorowicz (1981) are also similar. They had classified one of the poor reading groups as sequential reading disability type. They stated that the sequencing problem could result from a difficulty in learning to recognize orthographic regularity, a purely phonological difficulty in segmenting spoken syllables and words. They also recognized that the sequencing difficulty had less severe practical consequences.

However, Aaron (1982) proposed that the children who are deficient in sequential processing may find it difficult to read even phonetically regular script. He expected that such children depend on sight vocabulary and thus omit suffixes and inflections. When he studied such Tamil children he found them having difficulties in reading

suffixes and inflections, in Tamil as well as in English. But very few mispronunciations were observed. Tamil is phonetically regular but has a phonemic script and the ligaturing rules are quite different from those of Kannada which has a syllabic script. Aaron had used passages for testing. But in the present study the stimuli used were words which were not suffixed. Thus the findings have been different. The difficulties of the poor reading children observed in this study were limited to inaccurate reading which could be due to the 'sight-word' reading. The poor reading children could have been dependent on sight words as probably they could not sequentially analyze the stimuli.

It was observed that good readers and poor readers equally performed on the tests Auditory Sequential Memory and Visual Sequential Memory (Figure 8). However, when the performances were correlated with various reading measures certain patterns of relations were observed. For poor readers the sequential strategy was related to their performance on reading simple words. For good readers the strategy was related to reading complex syllables. It could be interpreted that poor readers were processing the words they could read, sequentially (and processing syllables simultaneously). Good readers who scored equally on sequential strategy, seemed to process the complex syllables which have more units in them sequentially (and were

generally able to process the reading stimuli simultaneously).

The findings of this study are in consonance with the findings that Cummins and Das (1977) have reported. Unlike in their study the Kannada subjects were classified into good and poor reading groups. In their study the subjects were grouped based on the scores on the processing strategy markers. Cummins and Das observed that reading and spelling tests were well correlated with sequential processing. They cite Das, Manos, and Kanungo (1975) that poor readers' reading achievement was found to be significantly related to sequential processing. Such pattern was also observed in this study. Cummins and Das also stated that for advanced skills in reading simultaneous processing is necessary. Similar findings are reported by Das, Kirby, and Jarman (1979) and Leong (1980). Similar is the finding in this study too.

In a later study Das and Cummins (1982) did not find any significant deficiency in the cognitive strategies of processing of poor readers. They found that "the RD children experienced difficulty in processing language in cognitively demanding situations but were equivalent to normal readers both in nonlinguistic tasks and in cognitively undemanding manifestations of language" (p 20). They explained that even when the poor readers have processing capacities they may not be able in making use of them

optimally when the situation calls for. In other words, poor readers may not plan adequately to use the strategies in solving the task and thus perform poorly. It was observed that the poor readers had performed comparably to good readers on nonlinguistic tasks, but not on reading.

The idea that the sequential and simultaneous strategies of processing should be used in a balanced way for normal reading has been emphasized (Aaron, 1982). There is also a view that the development of simultaneous abilities is important for better reading (Das, Kirby, and Jarman, 1979). However, though the strategies are thought to be independent they are thought to be contributing indirectly to reading (Leong, 1984, 1985). The findings are of a changing trend that it may be the planning (Das and Cummins, 1932) and language awareness (Leong, 1982, 1984, 1985) which may be contributing more directly to reading than the cognitive strategies.

The different strategies of processing also reflect the functioning of nervous system. While it is necessary to process language in a sequential manner, it also becomes necessary that such activity becomes automatic so that the information is processed for its content in relation to others meaningfully. Whereas for the former processing, the functioning of left hemisphere is essential, for the latter that of right hemisphere is necessary (Elliot,

Halliday, and Callaway, 1978).

From the findings of this study it can be said that the Kannada poor readers have difficulties primarily in processing the elements of print. This is the reason that they process the reading material inappropriately and misread. It is possible to speculate that they fail to process the stimuli appropriately in the left left hemisphere, for having not learnt the invariants of the stimuli.

Analysis of the component parts in reading is the function of the left hemisphere. In the right hemisphere the stimuli are processed simultaneously and automatically. The stimuli are processed in both hemispheres at the same time. EVen when the stimuli are processed in the right hemisphere automatically, still the reading may be incorrect because the subjects are not processing the details precisely. Leong (1980) discussing the laterality and reading states that "the right hemisphere superiority is more apparent in identity matching while the left hemisphere superiority occurs in the analysis of component parts" (p 189). Pirozollo and Raynor (1977) found that both hemispheres function independently in reading tasks. Whereas good readers not only learn the basic invariant features of reading using left hemisphere but also process them correctly and automatically when they process the same using right hemisphere. When called for, good readers can

process the stimuli predominantly either sequentially or simultaneously, i.e., they not only can read processing all the elements precisely but also read automatically. Poor readers are at a loss in both these capacities. Not only do they not read the stimuli processing the details precisely but also they do not read the stimuli automatically correctly.

The speculation is based on the belief that the left hemisphere that processes phonemes, the units of language, is also the base for processing the highly phonetically based script. for a Kannada reader spelling problems can not occur independent of spoken words, either in writing or in reciting. Whereas in English dissociation of spelling and reading are possible (Seymour and Porpodas, 1980), in Kannada it is not possible. Teaching method in Kannada invariably being synthetic children do not learn by word method and always learn by sounding/spelling the units. It is known that decoding and naming are processed by left hemisphere (Pirozollo and Raynor, 1977). Synthetic approach not only requires the children to hear (left hemisphere) but also needs them to learn by sequencing of those sounds increasing the dependence on the left hemisphere, particularly in the beginning. When the appropriate processing for decoding Kannada script in the left hemisphere does not occur the same is reflected in the right hemisphere's processing.

The findings in this study are in consonance with the findings of others that poor readers are slow decoders (Perfetti and Roth, 1981, Lesgold and Curtis, 1981). The contribution of orthographic knowledge seems to be paramount in Kannada reading. This supports the findings of Gibson (1969), Brooks (1977), Massaro, et al, (1980), and Singer (1982) that orthographic knowledge is very important for fluent reading. Kannada poor readers' main difficulty lies in their knowledge of orthographic rules. Morrison (1934), Schwartz and Doehring (1977) and many others have reported the poor readers' difficulties of orthography in English reading. The misreadings in Kannada due to difficulties in sequencing and of reversals are not considerable. The syllabic Kannada script provides inherent resistance for such misreadings. Considering the reversals in English reading (15%), such difficulties are insignificant in their occurance in Kannada (less than 1%).

The patterns of relationships observed between the cognitive strategies of information processing and reading are supportive of the findings of other studies. Good readers showed better relationship between simultaneous processing and reading. Poor readers' performance on reading was related to their sequential processing (Cummins and Das, 1977). However, in this study the relationships did not reach any statistical significance.

It is speculated that poor readers' processing for decoding in left hemisphere may not be as efficient as that of good readers. The speculation is based on the demands of Kannada script for reading and the method of teaching Kannada reading. Left hemisphere specializes in analytical and naming tasks whose processing is necessary for decoding graphophonic details. There is a one to one relationship between the script and the sound and reading is learnt by sounding each detail of the reading material. Also there is no dissociation of spelling and reading, and reading can hardly be wholistic, at least in the beginning. Good readers were found to read the material precisely as well as faster. They could process the material not only analytically but also wholistically.

Summarily the following can be stated. Behaviorally, automaticity in reading can differentiate poor readers from good readers. Knowledge of the rules of orthography is an important factor which can differentiate poor readers from good readers. The patterns of relations between reading and the cognitive processing strategies may be revealing the difficulties in the processing of reading.

3. Implications.

Automaticity is an important factor in learning to read fluently. Though practice may be a contributing

factor for automaticity, learning of the details of print is very important.

Knowledge of the rules of orthography is a very important factor in learning to read Kannada. Knowledge of the rules of orthography, particularly in reading phonetically regular scripts, will be highly contributing to fluency and precision.

Good readers are able to acquire the rules of orthography and automaticity in reading better than poor readers.

Poor readers of Kannada fail to read correctly whenever the syllables incorporate more than three ligatures in print. Poor readers also find the syllables with two or more consonants difficult to read.

Poor readers of Kannada also show poor graphophonemic associations and exhibit confusions among the letters of the alphabet.

Poor readers also do not make use of the cues provided in the immediate past in reading, exhibiting their difficulty in learning from cues.

Poor readers' difficulty in reading is a generalized one than specific to any level of script unlike among good readers who find only complex syllables difficult to read.

Specific kinds of misreadings, for example reversals, are not the characteristic of either poor or good readers of Kannada.

4. Suggestions.

In Indian education system, formal special education does not yet exist. When special education becomes a reality for Kannada reading children there need to be guidelines to implement reading correction procedures. There need to be diagnostic tests apart from other materials. A norm oriented and more extensive study is needed before constructing a test for diagnostic purposes. Such a study should include students as subjects from different socio-economic status and from various schools.

In training for the development of reading, the factors automaticity,and rules of orthography should be considered paramount. In individual remedial teaching, training in orthographic rules and practice in using those rules should be taken up. A program for explicitly teaching each type of regular and irregular instances of writing Kannada syllables has to be developed. Lessons for such a purpose can be produoed using general rules of orthography and findings of studies like the present one.

Separate studies can be taken up to learn about the

effect of various kinds and numbers of ligatures on reading. It is known that difficulties in reading increase proportionately with the number of ligatures in syllables. It is to be learnt whether different kinds of ligatures have different effects on their reading.

Further studies should incorporate the reading stimuli larger than individual words. The factors of morphology, syntax, and semantics have to be investigated in Kannada reading separately.

5. Limitations.

The study included only reading of individual words. Studying syntactic and semantic aspects of reading were not considered.

The subjects were limited in numbers as they were chosen from a single school to keep the homogeneity of the population.

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Appendix A

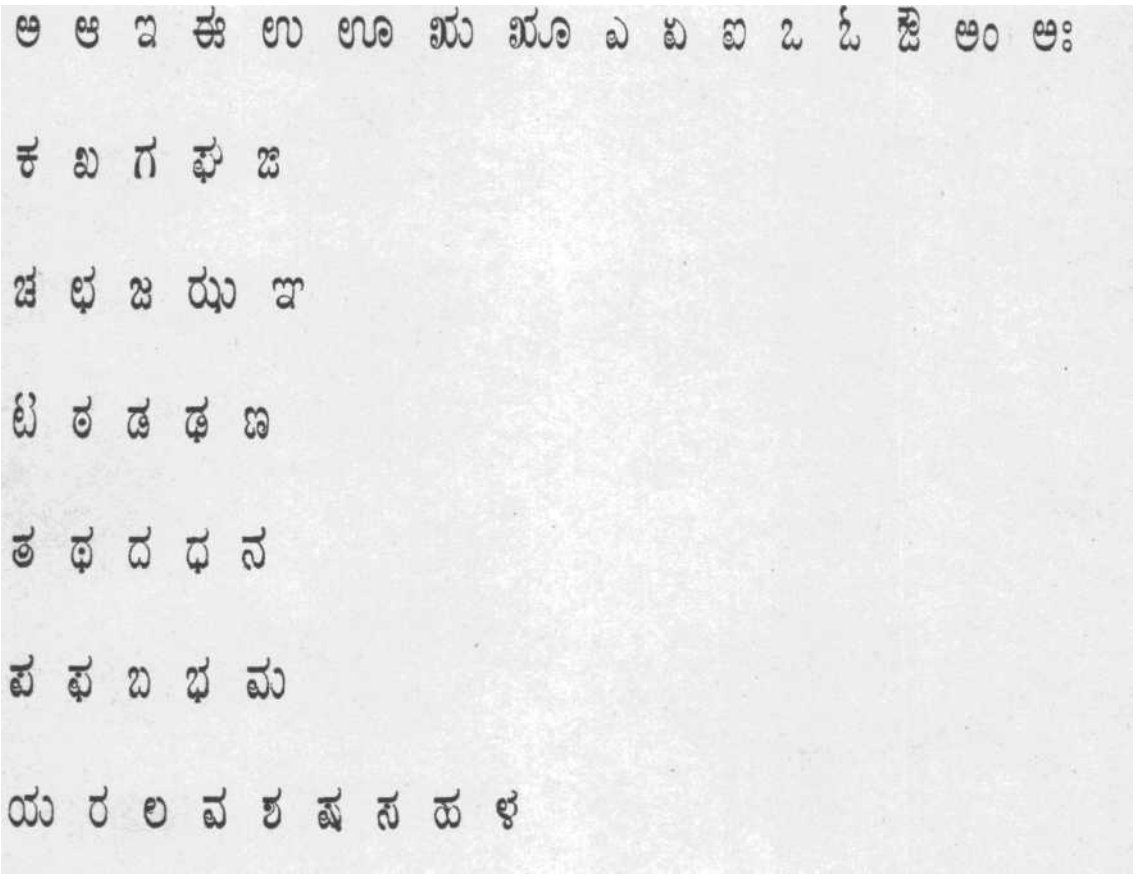
List 1. Items for word reading

ಅಗಲ	ಛಡಿ	ಮಳೆ	ಟೋಪಿ
ಆಗ	ಜಯ	ಯಮ	ಕುರ್ಚಿ
ಇತರ	ಝಳಕ	ರಮಣ	ಮೊರ
ಈಶ	ಟಿಗರು	ಲವ	ಮೋರಿ
ಉದಯ	ಮಠ	ವಶ	ಮೂಲಂಗಿ
ಊಟ	ಡಬ್ಬಿ	ಶಕುನ	ಹೂವಾಗಿ
ಎರಡು	ಢಣಢಣ	ಪುರುಷ	ಹಾಳೊಂದು
ಏತರ	ಮಣ	ಸರಸ	ಮಾವು
ಒಣ	ತನಕ	ಹರ	ಸಕ್ಕರಿ
ಓಟ	ರಥ	ಗಾಳ	ಮೊಗ್ಗು
ಔತಣ	ದನ	ದೇವರು	ಮುಚ್ಚು
ಅಂದು	ಗಂಧ	ದೊರೆ	ಅಜ್ಜಿ
ಕವ	ನಗರ	ದೀಪಟಿಗೆ	ಕಟ್ಟಿ
ಖಾದಿ	ಪಟ	ಜಾರು	ದಪ್ಪ
ಗಷಿತ	ಫಲ	ಜೌಗು	ಬಣ್ಣ
ಘಮಘಮ	ಬನ	ಜಂಬ	ಮುದ್ದು
ಚಮಚ	ಭಾರ	ಟೊಪಿಪು	ಕತ್ತು

List 1. continued

ತಿನ್ನು	ಕರ್ಣ	ಕರ್ಮ
ಕಪ್ಪೆ	ಅರ್ಥ	ತಿಂಗಳು
ಡಬ್ಬ	ಶಬ್ದ	ತಿಮ್ಮ
ತಿಮ್ಮ	ಬಡ್ತಿ	ಸನ್ನೆ
ತಾತಯ್ಯ	ರತ್ನ	ಸಂತೆ
ಕರ್ನಾಟ	ಸ್ವಲ್ಪ	ಮೀನು
ಜೆಲ್ಲು	ಆದ್ಭುತ	ಮಾನು
ಅಪ್ಪ	ಭಸ್ಮ	ವಿಧೇಯ
ಬ್ರಹ್ಮ	ನ್ಯಾಯ	ವಿಧೂರ
ಬಸ್ಸು	ಚಕ್ರ	ಲಕ್ಷ್ಮಣ
ಕಳ್ಳ	ಆಮ್ಲ	ಲಕ್ಷ್ಮಿ
ಸ್ಕೂಲು	ಧ್ವನಿ	ರಾಷ್ಟ್ರ
ನೀಯ್ದೆ	ವರ್ಷ	ಸ್ವಾತಂತ್ರ್ಯ
ಕಜ್ಜು	ವತ್ಸ	ಮೋಷ್ಟ್ರ
ಗರ್ಜನೆ	ಕಾರ್ಯ	ಐದು
ಇಷ್ಟ	ಕಾರ್ಯ	ಅಂತಃಕರಣ
ಬೋರ್ಡು	ಕರ್ಮ	

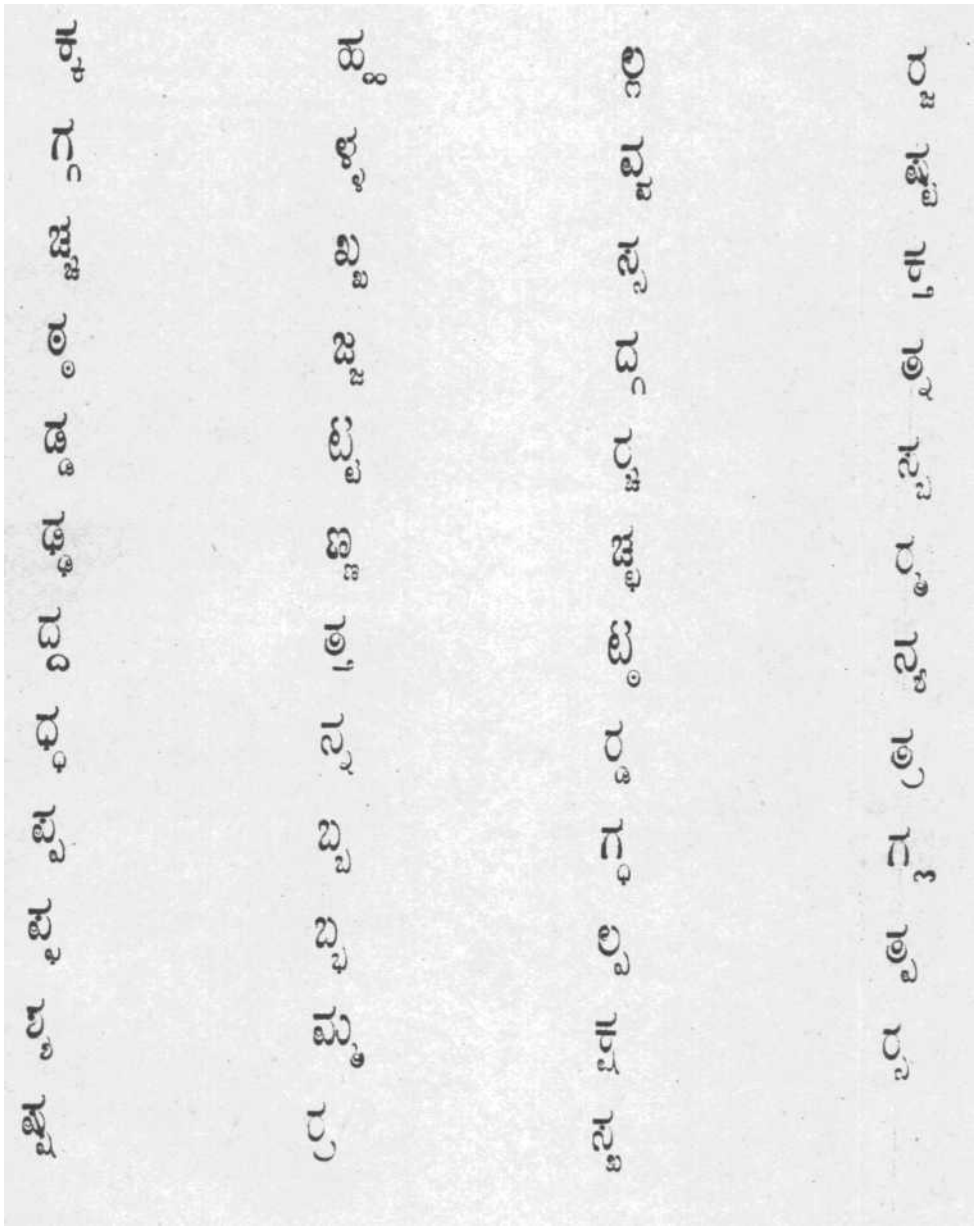
List 2. Letters of Kannada alhabet



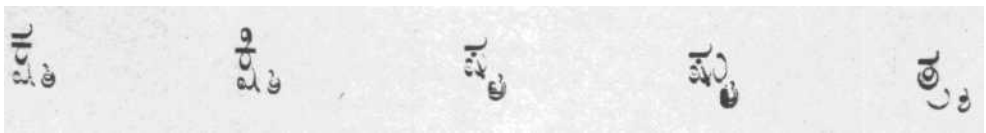
List 3. consonants with various vowels

ಗಿ	ಳೋ	ಮಾ	ವೊ
ಠು	ತೌ	ಯಿ	ಮೋ
ಡೂ	ಥಂ	ಙೀ	ಬೌ
ಢೆ	ದಃ	ಖು	ಯಾ
ರೇ	ಧೃ	ಫೂ	ಲೇ
ಸೂ	ಷಾ	ಟಿ	ಟೋ

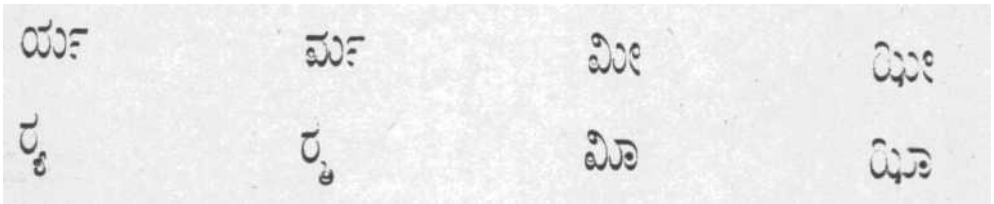
List 4. Geminated consonants and blends



List 5. Blends of three consonants



List 6. Syllables with alternate forms



Appendix B

Good readers Total no. of words per subject = 118

Subject	Reading at brief exposures	Reading at long exposures	Misread words
S	97	19	2
AGS	93	20	5
SK	70	25	23
PG	93	17	8
NR	65	33	20
AS	75	34	9
KRV	82	32	4
PMB	72	30	16
SCR	111	7	
SGN	82	23	13
Total	840	240	100

Poor readers Total no. of words per subject = 118

Subject	Reading at brief exposures	Reading at long exposures	Misread words
JPR	56	31	31
PJ	20	17	81
SM	20	25	73
NSV	53	28	37
STG	24	17	77
RBU	34	45	39
CGR	51	11	56
AC	33	22	63
AS	17	14	87
BTS	35	22	61
Total	343	232	605

Good readers Total no.of syllables per subject - 134

Subject	Reading at brief exposures	Reading at long exposures	Misread Syllables
S	121	8	5
AGS	123	7	4
SK	86	17	31
PG	116	10	8
NR	95	19	20
AS	94	22	18
KRV	119	9	6
PMB	102	20	12
SCR	120	11	3
SGN	118	14	2
Total	1094	137	109

Poor readers Total no. of syllables per subject =134

Subject	Reading at brief exposures	Reading at long exposures	Misread syllables
JPR	76	29	29
PJ	66	11	57
SM	45	31	58
NSV	82	18	34
STG	60	15	59
RBU	86	24	24
CGR	69	14	51
AC	68	11	55
AS	35	26	73
BTS	70	11	53
Total	657	190	493

Scores on the various tests of sequential and simultaneously strategies

Good readers

Auditory Sequential Memory	Visual Sequential Memory	Raven's Progressive Matrices	Memory for Designs
34	27	32	3
28	21	21	1
17	25	17	3
28	23	14	9
31	23	22	2
18	20	27	1
13	24	19	2
18	24	12	3
22	20	23	4
25	16	14	6
M 23.4	22.3	20.1	3.4
SD 6.87	3.13	6.26	2.46

Poor readers

Auditory Sequential Memory	Visual Sequential Memory	Raven's Progressive Matrices	Memory for Designs
16	22	13	6
24	21	20	3
14	22	17	11
23	20	19	4
19	23	22	6
20	16	11	5
20	33	20	6
15	31	14	2
52	22	9	13
24	23	15	11
M 22.7	23.3	16	6.7
SD 10.9	5.03	4.29	3.71