"VARIABLES AFFECTING RAPID READING: AN EXPERIMENTAL STUDY"

REG. NO. M-9415

PRIYA (KURIAN)

A DISSERTATION SUBMITTED AS PART FULFILMENT OF FINAL YEAR

M.Sc. (SPEECH AND HEARING) TO THE UNIVERSITY OF MYSORE, MYSORE

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MAY 1996

DEDICATED TO

MY BELOVED PAPPA AND MUMMY

WHO LOANED ME THEIR FAITH

BORROWED MY TROUBLES

SHARED GOOD TIMES AND BAD

AND GAVE ME THE LOVE AND PATIENCE

ONLY A PARENT CAN BESTOW

ON THEIR CHILD

AND

TO PREETHY

AS TIME GOES BY AND AS THE WORLD

KEEPS CHANGING

THE MORE I REALISE

THAT YOU ARE THE

GREATEST BLESSING IN MY LIFE

CERTIFICATE

This is to certify that this dissertation entitled **"VARIABLES AFFECTING RAPID READING: AN EXPERIMENTAL *STUDY"*** *is the bonafide.* work *in part fulfilment for the second year M.Sc. (Speech and Hearing) of the student with* Reg.No. M-9415.

M*ys o re*

May 1 9 9 6

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Mysore-570006

CERTIFICATE

This is to certify that this dissertation entitled **"VARIABLES AFFECTING RAPID REAPING: AN EXPERIMENTAL *STUDY"*** *has* been prepared under *my supervision and guidance.*

GUIDE

Mysore

May 1996

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DECLARATION

I hereby declare that this dissertation entitled "VARIABLES AFFECTING RAPID REAPING: AN EXPERIMENTAL *STUDY"* *is the result of my own study under the guidance* of ***Dr.* PRATHIBHA KARANTH,** *Professor and H.O.D., Department of* Speech *Pathology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other diploma or Degree.*

Mysoer

May 1996 **Reg. No. M-9415**

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Respected Madam, *your unfailing* guidance, *support and patience is what has made this study possible.*

As *they rightly s*ay "Ideals are *like stars in the sky.* We never re*ach them but like the mariners on the* beach we *chart our* course *by them". My respect for you sees no boundaries.*

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Dearest Pappa and Mummy, *you. are the dearest, most important people in all thz world to me ... because you. have* never s*topped believing* me. *I owe my life to you.*

Preethy, you'll always be a part of my life My hope and my inspiration, for all that I *achieve, through all my life' s journeys all I want is to love you always.*

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Thanks for your co - operation and you have shown that "a friend in need is a friend indeed" .

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Last but not the least, I *thank all those people, who helped* me *directly or indirectly, to get the report in this manner.*

Reg. *No.* M-9415

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INTRODUCTION

> Reading maketh a full man, conference a
> ready man and writing an exact man
>
> \- Francis Baecon

Education depends primarily on communication through spoken or written words. Reading is the deepening of peception and understanding through the intercommunication of minds using the medium of the written word. Reading is much more than mere word, phrase or even sentence recognition. Reading involves not only the skills of word recognition, but also comprehension," work-study and appreciation skills. Reading has dimensions that go far above and beyond the literal meaning of the printed word. But reading the printed word enables us to enjoy many of the good things in life, to communicate with each other and to share experiences of others through scientific records, stories and plays.

Reading is an essential social skill. Development of reading is an aspect of language and it has an important effect upon children, on their general development, their power of thinking and their cognitive development. Development of reading begins at age two with naming pictures in a book and proceeding to identify printed geometric forms at age three. Salient capital letters are recognized at around four years of age and salient printed words are recognized at around five to six years of age.

In the initial stages of reading printed words, children usually tend to read the word as a whole instead of recognizing the syllabic contents of the word. Later, the ability to identify the syllables in a word and then combine them to read out a word is achieved. As this skill develops, reading becomes more and more proficient.

With experience in reading, the rate of reading gradually improves. Reading takes place not by syllable to syllable reading but by rapidly scanning through the syllables/phonemes of the word and reading the word as fast as possible. For eg. reading rates of a college student varies from that of a primary school student.

There is much research literature on the perceptual identification of words. There are a number of factors which affect the reading rate. Most of the studies have been concerned with the effects of various word attributes such as frequency, length of the words, structural attributes, meaningfulness, pronounceability, concreteness and emotional connotations. Much of the literature that is currently available in this area however is based on alphabetic scripts like English and need to be verified with reference to nonalphabetic scripts such as syllabic and ideographic scripts.

This study is an attempt to find out the differences in reading rates due to the effect of variables like frequency, concreteness or abstractness, meaningfulness, syllabic length and orthographic complexity in a semi-syllabic script.

Application of such studies is found in work on the brain and dyslexic patients. Psycholinguistic theories derived from studies on normals are used to understand more about the nature and type of disorders found in dyslexic subjects and vice versa. An immediate and direct benefit of such an application is the refinement of remedial measures taken up in the field of psycholinguistics.

REVIEW OF LITERATURE

Reading which is a combination of visual and auditory images can be considered as a process of decoding printed symbols into sound and then extracting meaning from it. Conscious mastery of the relationship between phonology and orthography is a necessary precondition for the development of fluent reading.

Reading can take place by means of two routes. The first of these procedures is called the whole word procedure or the direct procedure. This depends upon the child having previously learned a direct correspondence between the letter string and the spoken representation. Here the words are read as a whole with no attention being paid to segment the word into its syllabic/phonemic constituents. Access to unfamiliar words is limited with this procedure. The second procedure is the phonologically mediated route (PMR) or the phonics procedure. Here spelling to sound rules are used to link print to pronounciation rather than previously learned direct correspondence between individual printed words and their spoken forms. According to PMR procedure phonemic reading takes place before access to meaning is gained.

Due to different theories of reading different methods to teach reading have been advocated.

They can be broadly classified as

1. Sight methods (whole word route) and
2. Sound methods (grapho-phoneme route)

Methods of teaching reading

Various methods of learning

1. Sight methods

a. Word wholes: The gestalt school of psychology offered a theory of perception based on gestalt or shape. The recognition of words by sight from their configuration and other visual features is the basis of the 'look and say' method of learning to read.

b. **Sentence method:** The different meanings (with different pronounciations) of the word depend closely on the words around it and their meaning and the order in which they are arranged. Thus it is argued that a child learning by sentence method will have clues to the nature and meaning of individual words from the rest of the sentence which are denied to someone learning entirely by word wholes.

2. Sound methods

a. The alphabetical methods

The learner is taught the names of the letters and has to recognize them by these names, eg. A - apple,B - bat, etc. When the pupil has acquired his alphabet, he is introduced to words. For each he is required to say the letters and then the word bee-ay-tee --> bat. By this means he memorizes the words and the spelling.

b. Phonic's methods

Here the letters are given their sounds and the pupil has to blend or run these into one another to make up the pronounciation of the word. This depends on his knowing the word already for no pronounciation of individual letter sounds build up exactly into the sound of the whole word.

c. Letter phonics

In this approach, individual letters are sounded and the sounds run together to approximate to the sound of the whole word. However the limitations are that there are only 26 letters in English, but these stand for over forty sounds. The visual way of dealing with this is to introduce the sounds in sequence in the early readers to ensure that the learner understands one way of sounding before proceeding to others.

Models of reading

Models of reading incorporate both routes and attempt to explain the process of reading and the disorders of reading.

I. Johston and McClelland's two stage model

One influential model has been proposed by Johnston and McClelland (1980). In the first stage, letter-position preprocessing, each letter in a word is simply segregated from its background, and its ordinal position noted. The outcome is that the word has been encoded as a sequence of unanalyzed visual blobs, each labelled with its ordinal position in the sequence of blobs. In the next stage, feature detection, each blob is subjected to feature analysis. At the next stage of abstract letter detection all 26 letters of the alphabet are represented by individual letter detectors. Every feature detector in the feature detection stage is linked to every letter detector stage. The letter detector for any letter is used to identify that letter regardless of its precise visual form. That is why the letter detectors are reduced to abstract, i.e. they do not provide information about specific visual form.

II. Frith's three phase model

Frith (1985) posits three kinds of strategies that characterize three different phases in her developmental model. Phase 1 is called a logographic phase. In this phase children learn words as visual forms, much as the children learn the characters of their logographic script. Phase 1 builds on metalincuistic awareness of instructional terms growth in recognizing whole words. These words usually represent concrete or 'picturable' concepts and objects. Phase 2 is described by Frith as the alphabetic phase. In this phase children acquire and learn to use the grapheme-phoneme correspondence. Frith suggests that explicit phonological awareness might be a critical mechanism supporting the transition from the logographic phase to the alphabetic phase.

The third and final phase is described as the orthographic phase, children can instantly analyse words into orthographic units (eg. frequently occurring letter clusters, such as the suffix or the syllable units sub and com) without phonological conversion. This ability is believed to be crucial if a reader is to achieve speed and fluency.

III. Non-lexical (rules) model

According to this model, depicted in figure 1, the pronounciation of a written word may be obtained by consulting the lexicon or it may be obtained nonlexically, through the use of a system of orthography to phonology conversion rules (Caramazza et al., 1986; Patterson and Shewell, 1987). Impaired access to the phonological lexicon would force reliance upon the non-lexical reading route and the quality of the resultant reading would depend upon the characteristics of the non-lexical pathway.

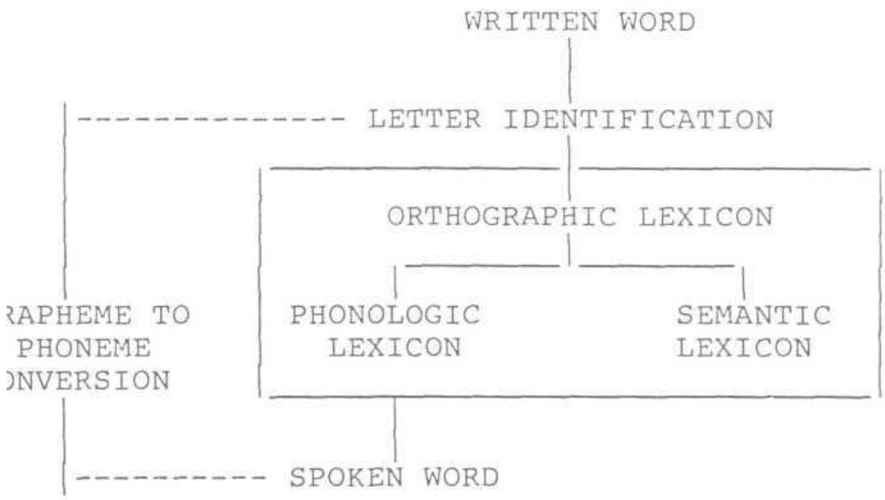


Fig. 1

Since this route is rule driven, one could expect oral reading errors on words whose pronounciations do not follow the rules of orthography to phonology conversion (i.e. irregular words).

IV. Lexical (no rules) model

According to this model (represented in Fig. 2), when a letter string is viewed, the corresponding entry in the orthographic lexicon is aroused. In addition orthographically "similar-neighbourhood" entries are aroused. The entry that is an exact match with the stimulus receives maximal activation; neighbourhood words receive only partial activation. If there is no exact match in the orthographic lexicon either because the subject is unfamiliar with the word or because it is in fact, a pseudoword, then no one orthographic entry receives maximal activation. A pronounciation is derived from the initially activated neighbourhood words in a process of 'analogy' (Glushko, 1979, 1981; Kay and Marcel, 1981) although the exact procedure by which this occurs are unclear. For example the pseudoword 'hin' might have activated the real words him, bit, pin and sin. These partially activated words combine to yield the composite pronounciation 'hin'.

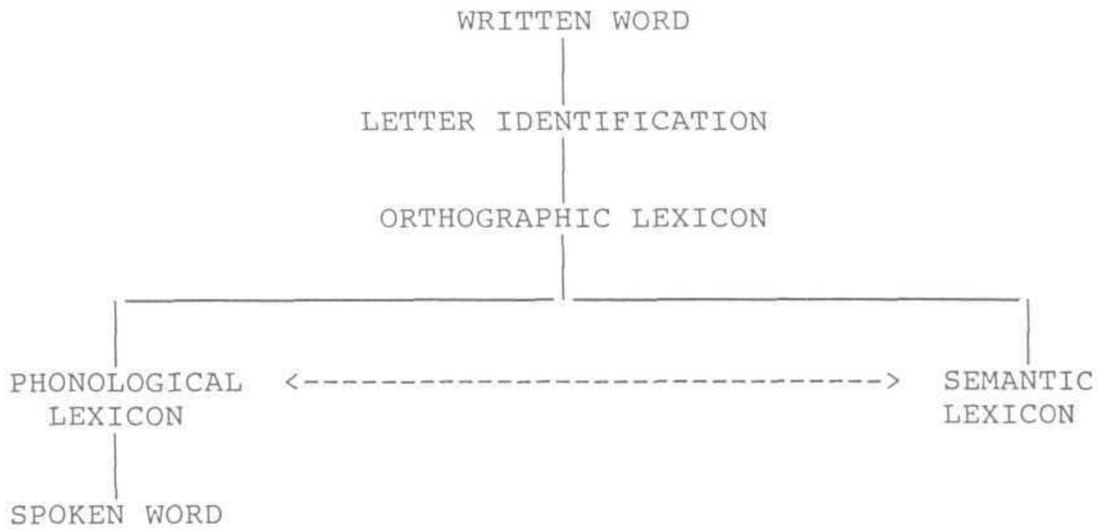


Fig. 2

Most of the theoretical models of reading as also much of the empirical work carried out to verify these theories have been based on readers of alphabetical scripts such as English.

Experimental studies on factors related to reading

Reading proficiency is rooted in language abilities. For more than 30 years, researchers have been investigating aspects of language knowledge as well as discrete language processing abilities that contribute to reading proficiency.

Literature reveals some variables which have an effect on naming speed and accuracy of reading. The frequency of occurrence of the word and length of the word in terms of number of letters and syllables have a well established effect. Other than this, the item type, i.e. whether it is a word or a non-word also has an effect on reading. In case of a word, the word class, concreteness abstractness of the word and the complexity of the word in terms of presence of initial and final syllable clusters have an effect on reading. In case of a nonword its orthographic legality or the phonological lawfulness, pronounceability, its structure and form in terms of being homophonous with a word, have an effect on reading. Summarizing the above mentioned variables, the following list has been obtained.

1. Word frequency
2. Word length in terms of number of letters and syllables
3. Concreteness vs abstractness of the word
4. Word class - noun vs verb
5. Word complexity - presence of initial and final syllable clusters

6. Word vs nonword
7. Nonword characteristics
   a. Orthographic legality
   b. Pronounceability
   c. Structure and form

Studies on response time measures

Concreteness vs abstractness

Rapid naming tasks have been proposed to reflect the ease with which the sound and meaning of a word is accessed. Psychologically, concreteness can be defined in terms of the ease with which the stimulus evokes an image of an object or objects, or simply as the picturability of a stimulus. Objects or their pictorial representations obviously arouse images directly and pose no conceptual problem in this context. Concrete terms presumably derive their meaning through association with concrete contextual association with other words, and nonverbal images and verbal processes as associative reactions. Abstract terms on the other hand derive their meaning largely through intraverbal experiences and more effectively arouse verbal associative than imaginal processes, although the latter could also occur as reactions to some abstract terms. Concrete and abstract words are thus distinguished primarily on the basis of their differential capacity to evoke concrete images as associative reactions, not on their verbal associative meaning (the number of verbal associative responses evoked by a word).

The positive effect of concreteness extends to variation within words alone. Jampolsky (1950) found slightly better recognition and a much lower number of false recognitions for concrete words than for abstract words. Gorman (1961) having categorized nouns as concrete and abstract on the basis of judge's ratings also found recognition memory to be much better for the concrete nouns. Gorman (1961) had controlled for frequency in her study, but neither experiment took, associative meaning into account. In as much as associative meaning correlates substantially with noun concreteness and imagery, the effective attribute is intermediate in both studies.

Olver (1965) attempted to vary concreteness and associative meaning independently in memory experiments. She was able to achieve only limited control over the variables because the necessary normative data on word attributes were available for only a relatively small sample of nouns at the time. Therefore imagery, concreteness and associative meaning were somewhat confounded. Despite this the result showed that concreteness had a slightly positive effect independent of meaning and frequency.

Borkowski and Eisner (1968) conducted experiments to find out the effect of abstractness and meaningfulness in short term memory (STM). Results indicated that abstractness had significant effect on the course of short term memory when varied independently of meaningfulness and frequency. Abstract words were difficult to recall than concrete words.

Paivio (1969) found that information embedded in concrete words is easier to learn than information conveyed in abstract words.

Wickens and Engle (1970) conducted an experiment to find out the effects of imagery and abstractness in short term memory. 256 subjects were run in a short term memory study designed to investigate whether or not words are encoded according to their imagery-abstract characteristics and in the experiment they found that performance on high imagery words were found to be superior to the abstract words. According to the authors, this may be because they produce less inter item interference than do abstract words.

Paivio (1971) suggested that imaging should facilitate recall of meaning of forming a "thema" and that dual coding (verbal and imaginal) is superior to single coding. Kintish (1974) has offered a viable explanation of the role of mental imagery. He suggests that high imagery words are represented in a subjective lexicon by a few strong relations while low imagery words enter into more relations with other words and these latter relations are more diffuse. When learning to associate a high imagery word with a printed form, readers should have a smaller pool of strong cues to choose from, making the correct response easier for them to encode and to retrieve.

Holmes and Langfogd (1976) compared the performance on abstract and concrete sentences in a sentence meaning classification task and in a free recall task. It was found that concrete sentences were classified significantly faster than abstract sentences. The results also showed that abstract sentences were completely omitted in recall, significantly more often than the concrete sentences and that given a recall attempt, significantly fewer words were recalled from abstract than from concrete sentences. These findings establish the existence of an effect of concreteness at the stage of initial sentence comprehension.

Paul and Katherine (1988) performed experiments to examine the context availability hypothesis for concreteness effects in lexical decisions. In the experiment it was found that equivalent lexical decision times were obtained for concrete and abstract words which had controlled context availability, whereas longer lexical decision times were obtained for abstract words than for concrete words, when the abstract words were rated lower in context availability.

Sarah (1989) found out that there was a large concreteness effect in the recall of sentences both in cases of monolinguals and bilinguals.

It can be concluded from the above studies that recognition memory is a direct function of stimulus concreteness. Recognition time i to concrete words to pictures. These findings are generally consistent with the interpretation that concreteness is related somehow to distinctiveness.

Frequency of the word

One of the earliest studies on the effect of relative frequency of occurrence of a word in English has been done by Howes and Solomon (1951). Their study attempted to find experimentally the function relating duration threshold to the relative frequency with which a word appears in the English language. Two experiments were conducted wherein the subject was instructed to respond whenever he felt ready to respond as the duration of exposure and not the latency was measured.

In the first experiment 60 words were made use of,30 were of high frequency occurrence while 30 of them appeared with relative rarity. The low frequency words were similar to and preferably synonyms of the common ones of the same value category. Results demonstrated a strong inverse relation between relative word frequency and duration threshold.

In the second experiment, several uncontrolled factors were forced upon the previous experiment. The words varied in length from 6-12 letters and were arranged in order of decreasing frequency. Results demonstrated the same relationship between duration threshold and long word frequency. It was also observed that practice trial decreased the duration threshold.

Linda and Bruce (1970) conducted an experiment to explore the effect of word frequency on verbal discrimination (VD) learning. The subjects learned a 10 pair list by either the recall or the anticipation method with either, 2, 3 or 6 seconds of study time per pair. These 10 pairs consisted of 5 pairs of each combination of either high or low word frequency. The results supported the frequency theory of verbal discrimination learning, i.e. high frequency words needs less reaction time compared to the low frequency words.

Paivio and Rowe (1970) also investigated the effect of frequency in verbal discrimination learning. Twenty subjects were given 8 study recall trials on each of 16 pair lists. Half of pairs in the list were high and the other half were low in word frequency. Here the noun imagery and meaningfulness were kept constant and it was found that fewer errors were made in the case of high frequency than low frequency pairs although the trend was not significant. It was also found that addition of one response (frequency) unit to a low frequency item results in a greater increment in correct response than the addition of one unit to a high frequency item.

Monsell, Doyle, Haggard (1989) compared the effect of frequency on lexical decision time with that on reaction time. They compared the effect of frequency on lexical decision time and naming latency for bisyllabic words. They had taken 24 subjects and 80 words. 20 words for each combination of frequency and stress placement (initial or final). High frequency words had frequencies between 34-155/million). It was found that naming latency for final stressed words was as frequency sensitive as the lexical decision time, whereas frequency sensitivity effect on the initial stressed word's naming was smaller.

The frequency with which a word is used in the language influences the response time in many reading tasks. Conventional models of visual word recognition have attributed such efforts to the frequency sensitivity of a lexical identification process that is common to all lexical "access" tasks and that precedes the retrieval of meaning or pronounciation and task specific decision process. The frequency of usage of words in the language has long been known to influence performance in tasks involving the recognition of the printed word.

McRae, Jared and Seidenberg (1990) investigated the loci of frequency effects in naming task. Frequency is commonly assumed to influence lexical access. However it could also influence processes involved in generating articulatory output. The stimuli were high and low frequency homophones (eg. MAIN/MANE), high and low frequency rhymes (eg. COLD/FOLD) and word/pseudophone pairs such as (SCAM/ SKAM). The stimuli differed only in frequency but were equated in terms of other factors relevant to articulation. The results suggest that there is a frequency effect.

Philip, Machelle and Donna (1992) examined the relationship between word frequency and lexical decision performance as stimulus onset asynchrony (SOA) was varied between the presentation of a letter string and a subsequent pattern task. In the experiments it was found that the subjects responded significantly faster as word frequency increased. Recognition sensitivity decreased as the word frequency decreased. These data indicate that word frequency advantages occur on a lexical decision task because the internal lexicon is coded as a function of word frequency and that word frequency advantages are not the result of verification effects or other later occurring processes.

Tainturier, Tremblay and Lecours (1992) examined the relationship between educational level and word frequency effect. It was postulated that individual's exposure to words that are rated lower in frequency tables should be greater among subjects with higher education and therefore hypothesized that the magnitude of the frequency effect should not be as marked within such a population as among subjects with a lesser educational level. A total of 40 neurologically healthy adults, half with an average of 18 years of formal education and the other half with an average of 11 years, participated in a lexical decision experiment. Results confirmed the hypothesis, that is significant frequency effects on reaction times were obtained in both groups but this effect was of greater magnitude for the less educated as opposed to the more educated subgroup.

Taft and Russel (1992) conducted an experiment to find out about the existence of the relationship between frequency and naming of pseudohomophones controlling orthographic factors. It was found that frequency effect resides in the connection between visually accessed lexical entries (the orthographic input lexicon) and the articulatory output (the phonological output lexicon). Such a connection is used in naming of words but not in the naming of pseudohomophones, as it is the phonological input lexicon that is used in the latter case, not the orthographic input lexicon. They further suggested that it is very easy to avoid the possible confounding effects of orthographic factors in pseudohomophones based on high and low frequency words in pairs, matching them on orthographic factors. This can be achieved by making exactly the same changes to high and low frequency words in order to create pseudo homophones.

Word length

Experiments were done by researchers where the lengths of the words were varied in terms of both syllables and letters. Forster and Chamber (1973) made use of 30 words which were divided as follows:

1/3 of the words - monosyllables of 4 letters

1/3 of the words - bisyllables of 4 letters

1/3 of the words - bisyllables of 6 letters

The subclassification of items according to the number of letters and syllables presented a number of potentially interesting results. Comparison of four letter monosyllables and four letter bisyllables reveals the effect of number of syllables with number of letters controlled, while comparison of the four letter bisyllables with the six letter bisyllables reveals the effects of number of letters, with the number of syllables controlled. The number of syllables had no significant effect on naming time, while the number of letters had a significant effect, with long words taking long time to name.

Stanners et al. (1975) varied the length of the word in terms of syllables. They made use of words which contained 5-7 letters which in turn were divided into monosyllabic and bisyllabic words of high and low frequency. Response latency was measured in a task which required the subjects to make a word-nonword decision to a visually presented item (Stanners, Jastrzembski and West Frock, 1975). The items were of either high or low frequency in the language words or well formed nonwords and either presented with normal visual clarity or degraded by a random dot pattern. While both frequency and item quality produced substantial effects for both words and nonwords, there was no indication of an interaction effect. The superiority of relatively high frequency items was almost exactly the same under degraded as under nondegraded condition. Item quality and the type of item (word, nonword) did show an interaction in that the latency difference between words and nonwords was much larger under degraded as compared to nondegraded conditions.

Braddley, Thomson and Buchanan (1975) explored the hypothesis that immediate memory span is not constant but varies with the length of the words to be recalled. Results showed that,

1. Memory span is inversely related to word length across a wide range of materials.

2. When the number of syllables and number of phonemes are held constant, words of short temporal duration are better recalled than words of long duration.

3. Memory span could be predicted on the basis of the number of words which the subject can read in approximately 2 seconds.

4. When articulation is suppressed by requiring the subject to articulate an irrelevant sound, the word length effect disappears with visual representation, but remains when presentation is auditory. The results are interpreted in terms of phonetically based store of limited temporal capacity which may function as an output buffer for speech production and as a supplement to a more central working memory system.

Monsell *et al*. (1992) made use of 180 words which were 3-11 letters in length. They were classified based on their syllabic length as follows.

74 - monosyllabic words

66 - bisyllabic words

32 - trisyllabic words

8 - quadrisyllabic words

They also made use of 180 nonwords which matched the words in distribution of lengths.

Each subject named 6 pure blocks (3 of word only, 3 of nonword only) and 6 blocks of half words and half nonwords. Each condition was preceded by one 'warm up' block of the same type. The order of pure and mixed blocks was counterbalanced over subjects. Within this order the order of the pureword and nonword blocks were counter-balanced; within that the assignment of A and B tests to pure and mixed conditions was counter balanced. Hence each item occurred only once per subject, but equally often in each condition for each order of testing. As some confounding effect of frequency and word length was suspected, multiple regression analysis with log frequency, number of syllables, number of phonemes and number of letters as the predictor variables was conducted. The unique effect of frequency was highly reliable for both pure and mixed lists. There was also a significant effect of number of syllables, but it differed little for words in pure (37.1 ms/syllable) and mixed (35.9 ms/syllables) lists.

Experiments on word-nonword classification have been found based on the hypothesis putforth by Rubenstein, Lewis and Rubenstein (1971). To find evidence for phonemic recoding in visual word recognition, three hypotheses were putforth. They are as follows:

a. A word is recognized by phonemic recoding when presented visually.

b. Phonemic recoding occurs during the quantization process, i.e. when the stimulus is segmented and the segments are assigned to letters, the letters are recoded into phonemes almost simultaneously.

c. It is the phonemic form of the stimulus lexicon that is compared to achieve the recognition of a word even when the word is presented visually.

45 subjects who were all university students were taken. The task was to decide accurately and quickly whether the word was English by pressing the key 'Yes' and 'No' for a word and nonsense word respectively.

Nonwords which have been constructed in the various experiments done on word-nonword classification can be of variable nature. The nonwords were varied in terms of its length, structure and orthographic legality or phonological lawfulness.

Rubenstein *et al*. (1971) made use of nonwords whose length varied from 4 to 5 meters. They were of two kinds:

1. Those nonwords which were homophonous with English words (eg. slic, trate) and

2. Those nonwords which were nonhomophonous with English words (eg. Melp, shart).

In another experiment by the same authors nonwords used were of three types:

a. Orthographically and phonologically legal (eg. basp)

b. Illegal nonwords which had a formal consonant cluster which never occurs finally as letters or phonemes in the final position in English (eg. Lamg) yet these nonwords were pronounceable.

c. Illegal nonwords which were unpronounceable.

This approach was presented to support the hypothesis that visual word recognition may involve recoding from grapheme to phoneme prior to any search of the internal lexicon. The approach was to show that in the case of nonsense words which are graphemically and phonemically illegal, the latency for visual recognition is shorter for less pronounceable words. This should occur even when the graphemic clues to their nonsense character are not more evident than for the more pronounceable words. The results showed that latency for legal nonsense words was longer than latency for illegal nonsense words of higher pronounceability which in turn was longer than latency for illegal nonsense word of lower pronounceability.

Stanners, Forbach and Headley (1971) investigated the decision and search process involved in word-nonword classification. The material they made use of consisted of words and nonwords. They were of mainly three categories (1) CVC (Sut), (2) *CVC* word (Sat), (3) *CCC* (Svt). In this study the frequency of occurrence of the initial and terminal consonants were taken into consideration. Initial consonants were of high and low frequency so was the case with the final consonant. Their study was based on the hypothesis that there are two stages of processing in deciding about a word classification. The first stage included the evaluation of an item for its phonological lawfulness. In the second stage,. a subset of memory is searched for semantic information.

According to this hypothesis, phonologically unlawful items are initially not encoded as units, and their rejection is based on a phonological evaluation rather than a search for semantic information. Results obtained indicated that the latency for CCC was the shortest, next v/as for CVC words and the highest for *CMC* nonword category. Results confirmed the hypothesis.

Smith and Haviland (1972) wanted to find out why words are perceived more accurately than nonwords. They took 24 Stanford University undergraduates, 15 males and 9 females participated. The material used consisted of 2 sets of 3 letter items, each set consisting of 8, three letter words and 8, three letter nonwords. The results showed that the reaction time was found to be lesser for words than nonwords. This is explained on the basis that when a word is presented, the subject's knowledge of the redundancy of English enables him to use the letters he analysed first to make inferences about the remaining letters or features and thus the remaining letters need not be fully analysed. According to their hypothesis, words are perceived more readily than nonwords because the units of analysis is larger in the former than the latter, i.e. when subject expects a word to be presented he segments the initial input into perceptual units which are larger than single letters and correspond to pronounceable English sequences and then analyse these units. But in nonwords he segments the initial input into individual letters and then analyses these letters. Thus words are perceived more accurately than nonwords because there are fewer units to extract and analyse in a word than in a nonword.

Forster and Chambers (1973) conducted an experiment to find out if there exists a correlation between naming time and lexical access. In the 60 items used, 30 were words and 30 nonwords. The nonwords were prepared by rearranging the letter of each of the words but preserving pronounceability. For example: over-vero, into-tino. Results indicated that words were named faster than nonwords. High frequency words were named faster than low frequency words. This strongly indicated that the naming process is not completed before the lexical status of the item has been established by a dictonary look-up; hence the more rapidly the lexical entry for a word is located, more rapidly naming can take place. A positive correlation exists between naming time and lexical decision time for words but not for nonwords.

A study by Novik (1974) using *CMC,* CCV words and phonologically lawful CCCs and unlawful CCCs indicated that the reaction times to lawful CCCs were consistently greater than those to unlawful CCCs. It was also found that word-nonword decision was not based on frequency determination.

In order to find out the effects of pronounceability on word-nonword encoding, Rubenstein et al. (1975) designed experiments in which subjects performed both a word-nonword categorization task. Reaction time increased with nonword pronounceability and decreased with realword familiarity. Common words and low pronounceability nonwords were categorized with equal speed. Error proportions were related to pronounceability in the same way as was reaction time. Recognition performance on items presented for categorization improved with nonword pronounceability and decreased with nonword familiarity. Rare words and highly pronounciable nonwords were equally well recognized which suggested that they were similarly encoded.

Stanners and Westbrook (1975) measured the response latency in a task in which subjects were asked to make a word-nonword decision to a visually presented item. The items were of either high frequency or low frequency in the language, words or well formed nonwords, and either presented with normal clarity or degraded by a random dot pattern. 60 under graduates were taken as subjects. A sample of 54 words was composed of 27 words each. Within the group itself there were 9 each of 5, 6 and 7 letter words. A nonword counterpart was constructed by changing only one vowel in the word. There was superiority of relatively high frequency whicn was found to be similar in both degraded and nondegraded conditions. It was also found that the latencv difference between words and nonwords was much larger under degraded as compared to nondegraded conditions.

Whaley (1978) conducted a study designed to investigate thoroughly the relative influences of an extensive set of variables. Response time data were collected from 32 subjects from 100 words and 100 nonwords which were matched for word length, letter frequencv, meaningfulness and age of acquisition. The nonwords were selected by taking a second set of 100 words from the same norms and changing one letter per syllable in each. The resultant words were pronounceable and few if any contained rare or unusual letter or phoneme sequences. The nonwords were also rated for their proximity to English word likeness.

Results showed that both word frequency and word length have been shown to affect the correct response latencies and it is now apparent that word frequency is by far the most powerful predictor.

Monsell et al. (1992) examined the lexical and sublexical translation of spelling to sound. They tested the hypothesis that assigning pronounciations to its, Orthographic constituents in regular and irregular words can be explained by a two process or dual route model. The two levels of processing are

a) A lexical level of mapping between whole strings and their learned pronounciations and

b) A sublexical level of mapping between constituent spelling patterns and their standard pronounciation.

Results indicated that the naming of nonwords was facilitated when the subject expected only nonwords rather than a mixture of nonwords and exception words and this facilitation was once again manifested only in latency and not in accuracy. Moreover this effect had led to the prediction that it should be observed only when the subject expected nonwords to be mixed with exception words of relatively low frequency. Therefore it can be concluded that readers strategicallv adjust to the expected presence or absence of exception words by adjusting their readiness to initiate articulation based on assembled output.

Summarizing the influence of various factors on naming latency, we can conclude that word frequency, structural attributes, meaningfulness, pronounceabilitv, concreteness, and emotional connotations influence the naming latency.

Numerous studies have shown that common words are easier to recognize than rare words. It seems likely that the time taken by the lexical process would also depend on the reader's experiences with a particular orthographic pattern and its association to the phonological form and hence on word frequency. Although common and rare words differ on other characteristics besides frequency, the frequency effect seems to be generally independent of such correlates.

The effects of structural attributes such as length, pronounceability and phoneme structure are also important. Length may vary in terms of number of letters or number of syllables. The structure of the respective language should be taken into consideration. Spoken words may be represented as a string of syllables on phonemes in different languages.

The experiments done in English have also shown that word concreteness and mental imagery, also paly a significant role in the latency of word recall with the mental imagery and stronger relations asserting in quicker recall of concrete words when compared to abstract words.

Indian studies

When you consider the Indian orthographic system it is a mixture of syllabic and alphabetic principles (Fukuzawa and Prakash, 1993). The alphabetic segments are combined to form syllabic units which are spatially delimited and in principle, each syllable form can be analysed into its consonant vowel components. The syllabary system may initially pose problems in terms of the multiplicity of symbols, the mastery of which may take a longer time. But once all the symbols are learnt, the nearly perfect grapho-phoneme correspondence of Indian orthography should make oral reading easier to even a functionally poor reader.

Roopa (1994) studied the naming latency in Kannada for words and nonwords of varied length, but matched for frequency, word class and concrete-abstractness. Around 256 words and 256 nonwords were used as material and this list was again subdivided and each subgroup was controlled in one of the influencing parameter such as word frequency, word length, etc. and it was found that words had shorter reaction time compared to nonwords. This result indicates that words are read by whole word route which is faster than PMR but PMR contribution is also present since when word frequency and other such factors are controlled there are still differences in reaction time for words of various length and complexity. A linear relationship between word length and reaction time has been found with the exception of the simple bisyllabic word. This is probably attributable to the relative infrequency of these word as compared to the tri and tetrasyllabic simple words.

Mathew (1995) conducted a study to see whether there was any significant difference between the reaction time for concrete and abstract words in Kannada. She had taken words matched for frequency, word length and complexity. The naming latency for these words were measured. Results showed that there was no significant difference in rapid reading between concrete and abstract words in a semisyllabic script like that of Kannada.

Mathew (1995) conducted another study in which she had taken words which were matched for all factors except the frequency. Results showed that there is no significant difference in reading rates between high and low frequency words. This is a contradiction to the conventional finding and this suggests that word frequency is a minor factor if you consider the rapid reading rate especially in semisyllabic scripts like Kannada. This may be accounted for by the fact that this script has a more transparent grapheme-phoneme correspondence.

In an alphabetical script like English, they make use of a letter by letter decoding process in reading. Here the reading takes place by linear decoding, i.e. the letters are arranged in a horizontal manner. Here the letters are grouped depending upon their linear sequence, eg.unbearable. In this example 'un' forms one group of letters, 'bear' another and 'able' the third group. The grouping is in a horizontal manner.

But a syllabic script like Kannada contains a syllable as a vertically delineated visual unit as against the horizontal sequence in an alphabetical script. The decoding here takesplace initially in a vertical manner where the grouping of letters in a syllable is already present in the written word. Here the units are syllables or syllable clusters which are grouped vertically,
eg.ಅಗಸ್ತ್ಯ (agastya) will be transcribed as v/cv/cccv/

Thus there is a difference in decoding alphabetical and syllabic scripts in terms of direction of decoding.

In alphabetical scripts a reader, based on his knowledge of the word breaks up a word into syllables present in the word. A reader in Kannada can easily say how many syllables a word contains as compared to a reader of English, on the basis of the visual configuration alone without access to word knowledge.

In the syllabic script a complex syllable such as a cluster, eg. CCCV would be presented as one visually complex form. For eg. in the word /agastya/ the third syllable /stya/ is written as one unit.

Given below are two words in the same script, while both are trisyllabic, one is orthographically simple and the other is complex.

eg. ಅಗಸಿ ಅಗಸ್ತ್ಯ

simple complex

If syllabic scripts are read syllabically, irrespective of simplicity or complexity of the syllable then both these words, should take the same time for reading, if they are matched for frequency. However if it is the number of letters (phonemes) that determine the length of the word, then the latter should have a greater naming time than the former. The differences can be attributed to the orthographic difference between the two.

To study the effect of orthographic features of Kannada, Roopa (1994) used complex words which contained a ccv cluster in it. She tried to find out the effect of length as measured in number of letters vs syllables and orthographic complexity. It was found that when same syllabic length is taken, complexity makes a difference, with complex words taking longer to read possibly because the syllables are not processed as single units but are further decoded into the number of phonemes they are composed of. The results of this study indicate that the number of letters is a more accurate measure of word length than the number of syllables. But again this effect was seen at longer word lengths that is at the tetrasyllabic level. At the bisyllabic and trisyllabic level there was no significant difference in reaction time between simple and complex words.

On the basis of limited studies which have been done on reading in Kannada, one cannot conclude that processing in a semisyllabic script like Kannada varies widely from that seen in alphabetical script like'English. A difference of opinion still persists as to which variables contribute to the speed of reading in scripts like Kannada. The studies in these semisyllabic scripts which draw conclusions that are different from those cited in western literature open new doors for research in the area of reading.

METHODOLOGY

The pronounciation of a visually presented word involves assigning to a sequence of letters, some kind of acoustic or articulatory coding. The function of the time taken to apply the phoneme-grapheme correspondence and then finding the word in the lexicon, is referred to as lexical access and naming time.

There are presumably two alternative ways in which this coding can be assigned. First, the pronounciation could be computed by application of a set of phoneme-grapheme correspondence rules. This coding can be carried out independent of any consideration of the meaning or familiarity of the letter sequence, as in the pronounciation of a previously unencountered sequence.

Alternatively, the pronounciation may be determined by searching long term memory for stored information about how to pronounce familiar letter sequences, obtaining the necessary information by a direct dictionary look up, instead of application of rules.

The previous study done in Kannada (Roopa, 1994) showed that word length in terms of number of letters is a more significant factor than the number of syllables.

Another study conducted by Mathew (1995) revealed the fact that there was no significant difference between the reaction time for high frequency vs. low frequency words as well as concrete words vs. abstract words. So the present study was conducted to verify these results. In the present study two more special word groups were taken. These cover the two graphemes in the Kannada syllabary which are exceptirns to the regularity of the rest of the Kannada syllabary, viz., the arka and the anuswara '0'.

For eg: Special group X_1 ಕಂತೆ – ಕತ್ತೆ (Kante-Katte)

Special group X_2 ಕರ್ಮ – ಕರ್ಮ (Karma)

The main aim was to find out whether there is any significant difference between the reaction time between these words and other irregular words.

In order to study the effect of concreteness vs. abstractness a list of concrete and abstract words were taken matched for their frequency, length and orthographic complexity.

To study the effect of word frequency word pairs matched for all factors other than the frequency were considered.

The effect of 'anuswara' in a word was calculated by taking words like kanthe-katte (ಕಂತೆ – ಕತ್ತೆ) where the canonical form of the words was identical but one word had the anuswara while the other was a gemminate. Similarly in pairs like ಕರ್ಮ-ಕರ್‍ಮ (karma) which were identical in terms of auditory/articulatory composition but differed in that the first word had the irregular arka. While the second was a homophonous but regular form though not in common usage, it was sought to tease out the element of irregularity in processing the arka.

Preparation of materials

Lists of words were prepared by controlling the following variables.

a. Word frequency

It is defined as the relative occurrence of the word in that language (Ranganatha, 1982). Two frequency bands were obtained.

1. Low frequency obtaining a score of less than 10
2. High frequency obtaining a score of 10 and above

b. Concreteness vs. abstractness of the word

Concrete words are ones which can be easily visualized or are highly imaginable.

Abstract words are ones which are less imaginable.

Both nouns and verbs have been classified as concrete and abstract words.

c. Word length

Was considered in terms of the number of letters. The words and nonwords were matched in terms of the number of letters they contained. The words and nonwords selected contained cvcv (group 1) cvccv/ccvcv (group 2) and ccvccv (group 3) combinations.

d. Orthographic complexity

The orthographic complexity varied in terms of the presence or absence of a syllable cluster in the word/ nonword and each pair of words were matched for orthographic complexity.

Controlling these variables described above, word lists were prepared in the following manner.

Two major lists were prepared.

One list of words and another list of nonwords. A total of 360 words were taken in which 180 were words and the rest 180 were nonwords.

These lists were divided into four groups.

Group A --> Contained 60 pairs of high frequency and low frequency words matched for all other factors and their nonword counterparts.

Group B --> Contained 60 pairs of abstract and concrete words matched for all factors except the concreteness and abstractness and their nonwords.

Group C --> Contained 30 pairs of special words and nonwords with and without 'anuswara' (i.e. anuswara and non-anuswara gemminated words and nonwords).

Group D --> Contained 30 pairs of special words and nonv/ords which can be written in two different forms in Kannada (i.e. arka and homophonous 'R' words and nonwords).

Non words were prepared by substituting consonants in a word by consonants belonging to the same subclass or by just interchanging the syllables in a word

eg. Kanda - danka

Kadda - dakka

A practice list of 15 pairs was also prepared to be presented before the experiment in order to make the material familiar to the subject. Word lists are given in appendix.

Selection of subjects

Subjects for this study had to meet the following criteria:

a. should be normal, healthy adult

b. should be in the range of 18-45 years

c. should have had atleast 10 years of formal education in Kannada

20 subjects were taken, who met the above criteria. Subjects were subdivided into four groups consisting of five subjects in each group.

PROCEDURE

The lists were programmed into a Macintosh computer where the application 'Psych Lab' was used for the experiment. In brief, the experiment specifies various parameters defining the events in the experiment, then chooses the input file containing the stimulus items and runs the experiment on line. Interstimulus intervals, response time and type can be specified. Measurements of naming latency is carried out in milliseconds. Mean and standard deviation for different responses on each trial are computed.

Subjects were instructed to press 'any key' as soon as they finished reading out aloud a word or nonword that had appeared on the screen. They were also instructed to read the word as fast and as accurately as they could. The four groups of subjects were presented with the blocks in the following manner, so that randomization of the order of presentation was done.

I group

^ i) a) High frequency words and nonwords

b) Low frequency words and nonwords

ii) a) Concrete words and nonwords

b) Abstract words and nonwords

iii) Special Group X_1

[(a) Words and nonwords with anuswara

(b) Nonanuswara gemminated words and nonwords]

iv) Special Group X_2

[(a) arka words and nonwords (ಕರ್ಮ form)

(b) irregular 'R' words and nonwords (ಕರ್ರ form)]

II group

i) a) Concrete words and nonwords

b) Abstract words and nonwords

ii) a) High frequency words and nonwords

b) Low frequency words and nonwords

iii) Special group X_2

iv) Special group X_1

III group

i) Special group X_1

ii) Special group X_2

iii) a) Concrete words and nonwords

b) Abstract words and nonwords

iv) a) High frequency words and nonwords

b) Low frequency words and nonwords

IV group

i) Special group X_2

ii) Special group X_1

iii) a) High frequency words and nonwords

b) Low frequency words and nonwords

iv) a) Concrete words and nonwords

b) Abstract words and nonwords

All groups were first presented with a practice trial of 30 items. A reinforcement was provided to the subject after the practice trial regarding their performance. This helped the subjects to improve their responses on the experimental trials. The responses were recorded on an audio tape. The incorrect responses were not considered. The reaction time measures recorded by the computer were then analysed to obtain the results.

RESULTS AND DISCUSSION

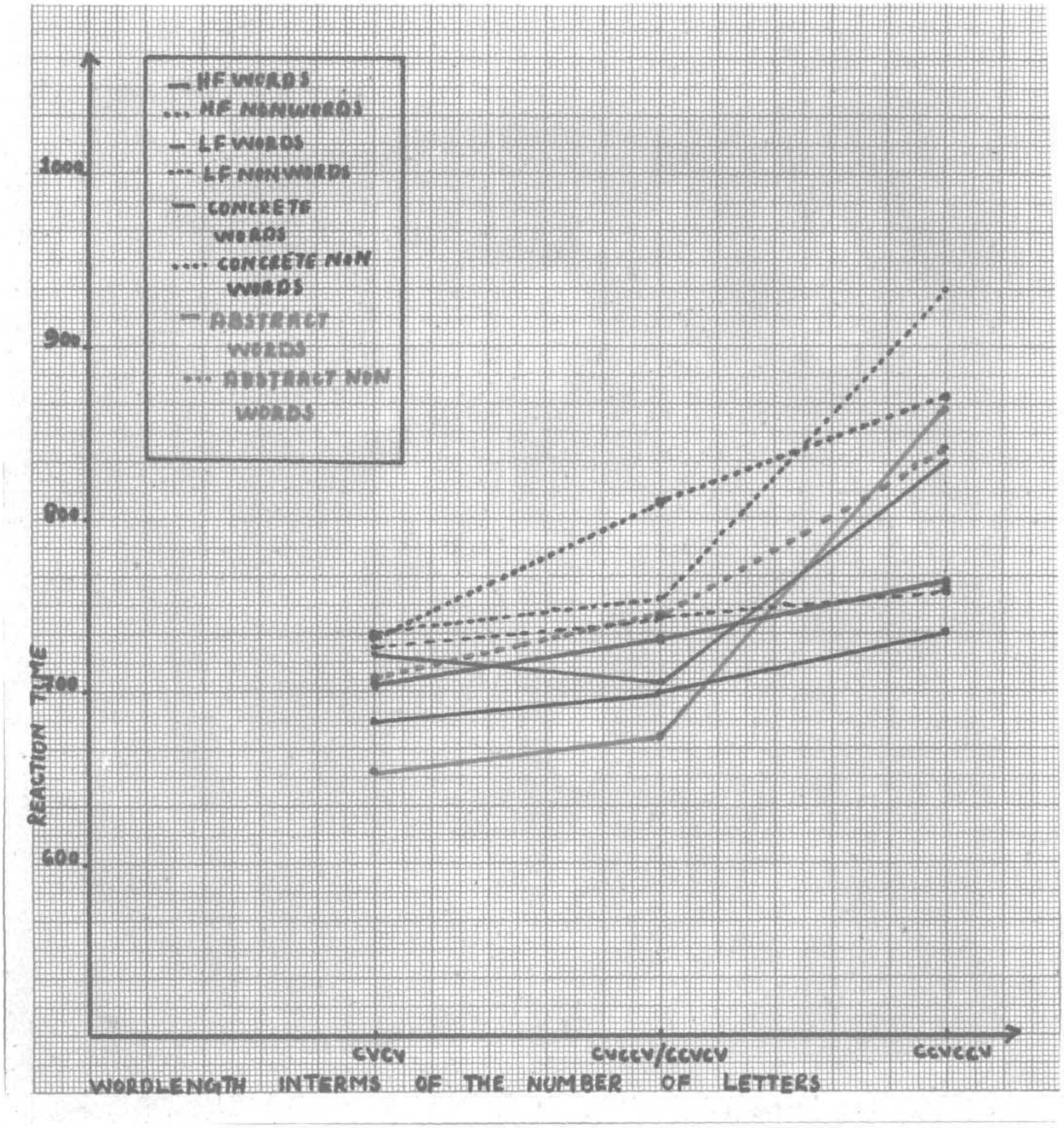
Most of the studies on the perceptual identification of the words have been concerned with the effects of various word attributes such as frequency, structural attributes, meaningfulness, pronounceability, concreteness and emotional connotations. Much of the literature that is currently available in this area is based on alphabetic scripts like English. There have been a few studies done in nonalphabetical scripts such as Kannada in the recent past. In processing scripts like Kannada, the length of the word in terms of the number of phonemes, was found to be a major factor when compared to other attributes such as frequency, concreteness, abstractness, etc (Roopa, 1994). Anu Mathew (1995) found that the frequency as well as the concrete abstract word effects did not have a significant effect on reading speed in Kannada. In view of the fact that these observations contradict western findings, this study was conducted in order to verify these results. The current study also attempts to find out whether there is any difference in the reaction time between words and nonwords and also any difference is seen between the relatively irregular anuswara and nonanuswara gemminated words. In addition two groups of words which could be written in two different forms, eg. (arka and homophonous R words) in Kannada were also studied to probe the effect of familiarity. The mean RTs obtained by the subjects on the different groups of words is given in Table 1.

Table 1

Mean values of different types of words and nonwords

	Group 1	Group 2	Group 3
HF words	703.057	729.710	763.050
HF non-words	730.484	810.610	870.279
LF words	720.285	705.900	836.287
LF non-words	733.636	752.550	932.513
Concrete words	684.469	698.459	739.583
Concrete non-words	724.793	733.935	739.583
Abstract words	656.574	672.031	867.601
Abstract non-words	718.136	746.416	845.209

Group 1 - CVCV; Group 2 - CVCCV or CCVCV; Group 3 - CCVCCV



Graph 1: The reaction time for words and nonwords of different types

From table 1 as well as from graph 1 it is obvious that there is an increase in word length with the exception of bisyllabic CVCV combination (Group 1) for low frequency words. This replicates Roopa's (1994) results.

In the case of high frequency words as well as concrete words, even though there is an increase in the reaction time, it is not significant. But in the case of low frequency and abstract words there is a significant length effect.

Table 2

The level of significance in the case of length effect for high frequency, abstract and concrete words and nonwords

Word type		p value	Significance
HP	Words	0.1361	Not significant
	Nonwords	0.0308	Significant
LF	Words	0.0005	Significant
	Nonwords	0.0001	Significant
Concrete	Words	0.0682	Not significant
	Nonwords	0.6407	Not significant
Abstract	Words	0.0001	Significant
	Nonwords	0.0024	Significant

From table 2 it is seen that this length effect is more for low frequency words, abstract words and nonwords of all types. While there is an overall linear effect in the time taken to read with increase in the number of phonemic units, this results in a significant increase in the time taken for reading low frequency words, abstract words and nonwords. The length effect is found to be more pronounced in these conditions. This may be because these words and nonwords makes greater use of the phonologically mediated route for reading.

2. Frequency effect

Naming time was measured for words and nonwords of varied length. Here all the factors were kept constant except the frequency. The categories taken were HF words, HF nonwords, LF words and LF nonwords. In each group there were 30 words each.

Paired 't' test was done to find out whether there is any significant difference in RT for HF and LF words and nonwords.

Table 3

The level of significance for the reaction time of high and low frequency words

	DF	Mean X-Y	Paired t value	Prob (2 tail)	Significance
HF }Group 1 words LF	19	17.229	0.587	0.564	Not significant
HF }Group 2 words LF	19	-31.301	-0.724	0.478	Not significant
HF {Group 3 words LF	19	73.238	3.172	0.005	Significant

From table 3 it is clearly seen that there is no significant difference in the reaction time for high and low frequency words except for group 3 combination. This is in support of Anu Mathew's study (1995) where she found that there is no significant difference in the reaction time taken for high and low frequency words. This again supports the fact that frequency does not affect reading speed at shorter word lengths, but plays a role in the reaction time at higher word lengths such as group 3 words where there is a significant difference in reaction time for high and low frequency words.

3. Concreteness vs. Abstractness

Naming latency for concrete and abstract words matched for frequency, word length and complexity was measured to study the effect of word type if any on the contribution of established factors in rapid reading in Kannada. The list contained concrete and abstract words.

Paired 't' test was done to find out whether there is any significant difference in reaction time for concrete and abstract words and the results are given in Table 4.

Table 4

The level of significance for reaction times of concrete and abstract words

		DF	Mean X-Y	Paired t value	Prob (2 tail)	Significance
Concrete and abstract	Group 1 words	19	-27.895	-1.24	0.23	Not significant
Concrete and abstract	Group 2 words	19	26.429	1.67	0.1113	Not significant
Concrete and abstract	Group 3 words	19	128.018	3.955	0.0008	Significant

This finding again replicated the findings of Anu Mathew (1995) where she had found that there is no significant difference between reaction time for concrete and abstract words. In the current study a significant difference in reaction time (RT) in group 3 words was found between abstract and concrete words. This perhaps can be explained on the basis of the relative infrequency of these types of words when compared to other combinations. Because of the relative infrequency, concreteness and abstractness appear to play a role in determining the RT along with word length.

In general this suggests that in semi-syllabic scripts like Kannada, which have a near perfect and more transparent grapheme to phoneme correspondence compared to the more complex alphabetic script of English, word length plays a major role in the rate of reading while word frequency and word type effects are not as significant at least at shorter word lengths.

4. Words vs. nonwords

As seen in graph no. 1 it appears that there is a significant difference in the RT for words and nonwords. The mean values as well as the level of significance for words and nonwords are given in tables 5 and 6.

Table 5

Mean values of different types of words and nonwords

	Group 1	Group 2	Group 3
HF words	703.057	727.075	763.050
HF non-words	730.484	831.250	870.279
LF words	720.285	698.773	836.287
LF non-words	733.636	749.343	932.513
Concrete words	684.469	698.459	739.583
Concrete non-words	724.793	733.935	760.733
Abstract words	656.574	672.031	867.601
Abstract non-words	718.136	746.416	845.209

Group 1 - CVCV; Group 2 - CVCCV or CCVCV; Group 3 - CCVCCV

Table 6

The level of significance for group 1, 2 and 3 words and nonwords

Words and nonwords	DF	Mean X-Y	Paired t value	Prob (2 tail)	Significance
HF group 1	19	-27.427	-1.700	0.1054	Not significant
HF group 2	19	104.175	5.124	0.0001	Significant
HF group 3	19	107.229	1.755	0.0954	Not significant
LF group 1	19	13.35	0.723	0.4787	Not significant
LF group 2	19	53.57	1.292	0.2119	Not significant
LF group 3	19	96.225	2.218	0.0389	Significant
Concrete group 1	19	40.324	2.612	0.0171	Significant
Concrete group 2	19	35.475	2.292	0.0335	Significant
Concrete group 3	19	-21.150	-0.503	0.6206	Not significant
Abstract group 1	19	61.563	3.828	0.0011	Significant
Abstract group 2	19	74.385	3.237	0.0043	Significant
Abstract group 3	19	-22.392	-0.549	0.5891	Not significant

Results indicate that there is a significant difference in RT for words and nonwords. This difference was found to be very significant in HF group 2 words and nonwords, LF group 3 words and nonwords, concrete group 1 words and nonwords, concrete group "2 words and nonwords, abstract group 1 words and nonwords and abstract group 2 words and nonwords. In other combinations also there is difference in RT for words and nonwords as seen in tables 5 and 6, but this difference was not that significant. The results indicate that nonwords take longer time than words. This supports the hypothesis that words are read by whole word route which is faster than the phonologically mediated route. From table 5 it is clearly seen that in the case of nonwords there is a linear increase in the RT when word length is increased in terms of the number of letters. This is in agreement with the study conducted by Roopa (1994) where she had found a clear cut difference in words and nonwords in the case of reaction time.

Mainly two types of exceptional words were taken. They are anuswara and nonanuswara gemminated words and arka and homophonous 'R' words, eg. ಕಮ್ಮ-ಕರ್ಮ The RT for these words are given in table no. 7.

Table 7

The mean values of the RT for anuswara, nonanuswara gemmenated words and nonwords, arka, irregular 'R' words and nonwords

	Mean		Mean
Anuswara word	744.230	arka word	772.013
Anuswara nonwords	806.932	arka nonword	949.708
Nonanuswara gemminated word	831.527	Homophonous 'R' word	751.146
Nonanuswara gemminated nonword	799.523	Homophonous 'R' nonword	878.971

Table 8

The level of significance for RT of words and nonwords

Words and nonwords	DF	Mean X-Y	Paired t value	Prob (2 tail)	Significance
Anuswara words & nonwords	19	-62.703	-2.029	0.0567	Significant
Nonanuswara gemminated words & nonwords	19	-87.297	-3.108	0.0058	Significant
Arka words vs nonwords	19	-177.684	-6.377	0.0001	Significant
Irregated 'R' words vs nonwords	19	127.824	5.134	0.0001	Significant

From table no. 8 it is seen that RT is significantly different for words and nonwords. This supports the hypothesis that nonwords are read by phonologically mediated route.

Another question looked at was whether there is any significant difference in RT for anuswara and nonanuswara gemminated words as well as arka words and homophonous 'R' words.

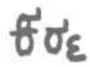
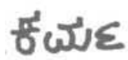
Table 9

Level of significance for RT for anuswara and nonanuswara gemminated words and arka and irregular 'R' words

Words and nonwords	DF	Mean X-Y	Paired t value	Prob (2 tail)	Significance
Anuswara and nonanuswara gemminated words	19	-87.297	-3.108	0.0058	Significant
Arka and homophonous 'R' words	19	20.867	1.010	0.3251	Not significant

From table no. 9 it is seen that there is a significant difference in RT for anuswara and nonanuswara gemminated words. But between arka and homophonous 'R' words there was no significant difference seen.

From table no. 7 it is obvious that anuswara words take shorter time than nonanuswara gemminated words. Words with anuswara behave as though,the phonemes are lesser than that in the words of nonanuswara gemminated group. From the previous results it was shown that RT decreases when the word length in terms of the number of phonemes decreases. This result perhaps can be explained based on the hypothesis that the anuswara which nasalizes the following consonant is processed as a feature of the latter rather than as a separate phoneme.

When you consider the arka words and homophonous 'R' words (), the homophonous 'R' words are not used in the written form of Kannada frequently. So the processing of their words should be somewhat like nonwords. The fact that there is no significant difference between RT for words of two forms and that the mean RT for arka words is in fact higher than that of their homophonous counterparts suggests that the arka form () is processed like a nonword. Moreover the RT for these words resemble the RT for nonwords of other groups such as the LF, HF, abstract and concrete nonwords. This supports the hypothesis that these words are influenced largely by the phonologically mediated route.

These results can be summarized as follows:

- Length plays an important role in determining the reaction time.
- There is no significant difference in RT for HF and LF words except for group 3 words.
- There is no significant difference in RT for concrete and abstract words except for group 3 words.

- There is a significant difference in RT for words and nonwords.
- There is a significant difference in RT for anuswara and nonanuswara gemminated words.
- There is no significant difference in RT for arka and irregular 'R' words.

When you consider the alphabetical scripts like English, there is a clearcut difference seen between HF and LF words as well as concrete and abstract words. From this study it can be concluded that frequency as well as word type play a relatively minor role compared to word length, in scripts like Kannada. So all these factors as well as these effects should be considered when a theoretical model is proposed.

SUMMARY AND CONCLUSION

Proficient reading is a skill developed through years of experience. Various factors influencing this ability like word type (concreteness and abstractness), word frequency, word length, meaningfulness of the word, orthographic complexity, etc. were controlled and rapid reading tasks were assigned to subjects, in Kannada. Subjects had ten years of formal education in Kannada. The experiment was carried out using a Macinthosh computer. Results showed a difference in reading rates between words and nonwords suggesting the usage of whole word reading route in the reading of words. Since a difference in reading rates of simple and complex words was found,it was concluded that the phonologically mediated route also contributed to word reading along with the whole word reading. The results showed that word length in terms of the number of phonemes plays a major role in determining the reaction time, i.e. there is an overall linear effect in the time taken to read with increase in the number of phonemic units. This was significant for low frequency words, abstract words and nonwords. It was also found that there was no significant difference in reading rates between concrete and abstract words and between low frequency and high frequency words except for CCVCCV combination. This suggests that in semisyllabic scripts like Kannada, word length is a major factor contributing to rapid reading while word frequency and word concreteness and abstractness played a minor role. This is possibly accounted for by the fact that this script has a more transparent grapheme to phoneme correspondence which enabled the reading of both concrete and abstract words and high frequency words and low frequency words with equal rapidity. The conclusion is in agreement with that of the previous studies in Kannada (Roopa, 1994 and Mathew, 1995)

In the current study, it was observed that when the word length increased upto CCVCCV combination, there was a frequency effect as well as" concreteness, abstractness effect. So it would be interesting to probe the effects of frequency and word type at greater word lengths.

Another question looked at was whether there is any significant difference in RT for anuswara and nonanuswara gemminated words as well as arka words and homophonous 'R' words. It was seen that anuswara words take shorter time than the nonanuswara gemminated words. This may be explained based on the hypothesis that anuswara which nasalizes the following consonant is processed as a feature of the latter rather than as a separate phoneme.

No significant difference in RT was seen for arka and homophonous 'R' words. The homophonous 'R' words are not used frequently in the written form of Kannada. So the processing of these words should be somewhat like nonwords. The fact that there is no significant difference between RT for words of these two forms indicate that even the arka words are processed like a nonword.

Implications of this study

1. Rapid reading in semisyllabaries like Kannada are not affected to the same extent by variables such as word type and frequency as in alphabetic scripts like English.

2. Unlike alphabetical scripts like English, word length in terms of the number of phonemes plays an important role in semisyllabaries like Kannada.

3. Studies such as these are required in investigating into the nature and type of reading and dyslexia in Kannada.

4. Further investigation need to be carried out with words of increasing length to see if word type and word frequency effects are noticeable at longer word lengths and with greater number of subjects.

5. The presence of 'anuswara' in a word affects the reaction time in rapid reading in Kannada. It would be interesting to further investigate at which age level the child processes the anuswara which nasalizes the following consonant as a feature of the latter rather than as a separate phoneme.

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HIGH FREQUENCY

CVCV

Words	Nonwords
ಕಡೆ	ಡಕೆ
ಕೆಲ	ಲಕ
ಕತೆ	ತಕೆ
ಕಾಲು	ಲಾಕು
ಕೂಡಾ	ಡೂಕೆ
ತಾವು	ವಾತು
ಫಾಪಾ	ಫಾವು
ತರೆ	ಲಸೆ
ಮಗ	ಗಮ
ಹೇಳು	ಹೊಳೆ
ನೀಡಿ	ಡೀನಿ
ನೂರು	ರೂನು
ನೀನು	ನೂನಿ

CVCCV

Words	Nonwords
ನ್ಯಾಯ	ದ್ಯಾಪ
ಕ್ರಮ	ಮ್ರಕ
ವ್ಯಾಸ	ಸ್ಯಾವ
ಸ್ವಾಮಿ	ಸ್ಮಾಮಿ
ಪ್ರಾಣ	ಕ್ರಾಪ

CVCCV

Words	Nonwords
ಕಣ್ಣು	ಡಂಕು
ಕಂಡು	ಡಂಕ
ಕಂಡ	ಟೆಕ್ಕ
ಕಟ್ಟೆ	ಟಕ್ಕ
ಕೆಟ್ಟ	ದಂಬ
ಬಂದ	ದಗ್ಗು
ನದ್ದು	ಟುಮ್ಕೆ
ಮಟ್ಟೆ	ನಮ್ಮು

Words	Nonwords
ಸ್ವಲ್ಪ	ಪ್ನಸ್ವ
ಪ್ರಶ್ನೆ	ಸ್ನಪ್ಶೆ
ವ್ಯಕ್ತಿ	ಕ್ಯತ್ವಿ
ಸ್ವಂತ	ಸುತ್ವ

LOW FREQUENCY

CVCV

Words	Nonwords
ಕಣಿ	ಕಪೆ
ಕಣ	ನಕ
ಕೆರೆ	ಕಟೆ
ಕಾರು	ರಾಕು
ಕಾಟ	ಟಾಕು
ತಾಸು	ಸಾತು
ಪಾಕ	ಕಾಪ
ತೆರೆ	ರೆತೆ
ಮಣ	ಲಮು
ಕೇಳು	ಲಯಾಕೆ
ನೀತಿ	ತೀನಿ
ಯಾಲು	ಲಯಾನು
ನೀಟು	ಟೀನು

Words	Nonwords
ನ್ಯಾಸ	ಸ್ಯಾನ
ಸ್ಥಳ	ಸ್ಳಥ
ಕ್ಷಮ	ಡ್ಯಮ
ಪ್ರಾಣಿ	ತ್ರಾಪಿ
ಪ್ರಾಸ	ಸ್ರಾಡ

CVCCV/CCVCV

Words	Nonwords
ಕಬ್ಬು	ದಂಕು
ಕಂದು	ದಂಗ
ಮಂದ	ಜಕ್ಕ
ಕಜ್ಜಿ	ಲಕ್ಕ
ಕಳ್ಳ	ದಂಕ
ಸಂದ	ದನ್ನು
ಹದ್ದು	ಟಕ್ಕೆ
ಕತ್ತೆ	ನಜ್ಜು

CCVCCV

Words	Nonwords
ಸ್ವಪ್ನ	ಸ್ನುಕ್ವ
ಪ್ರಶ್ನೆ	ಗ್ರಪ್ನೆ
ಸ್ವರ್ಗ	ಸ್ರಗವ
ಟ್ರಂಕು	ಕ್ರಪ್ಪು

CONCRETE WORDS

Words	Nonwords	Words	Nonwords
ಕಾಡು	ಡುಕ	ಪ್ರಾಣಿ	ಬ್ರಾಪಿ
ಬಾಲ	ಗಾಬ	ಗ್ರಾಮ	ಪ್ರಾಗ
ಗಾಳಿ	ಲಾಗಿ	ಸ್ಕೂಲು	ಕ್ಲೂಸ
ಬಾಂಬು	ವಯಾಚ	ಕ್ರೀಡೆ	ಡ್ರಾಕೆ
ಹಾಲು	ಲಾಹು	ಕೂಪು	ಬ್ರಾಕು
ದಾರಿ	ರಾದಿ		
ಕರು	ರಕು		
ಕವಿ	ವಕಿ		
ಕೋತಿ	ತೋಕಿ		
ಗಾಡಿ	ಡಾಗಿ		
ಕೋಣೆ	ನೋಕೆ		
ತಾತ	ತಾತಿ		
ಕಸ	ಸಕ		
ಜೇನು	ಗಾಜ		

Words	Nonwords	Words	Nonwords
ಹತ್ತಿ	ತಿಸ್ಸ	ಸ್ವಪ್ನ	ಸಂಸ್ವ
ಕತ್ತಿ	ತಿಲ್ಲ	ಟ್ರಕ್ಕು	ಕ್ರತ್ತು
ಬಣ್ಣ	ನಬ್ಬ	ಸ್ವರ್ಗ	ಗ್ರಾಸ್ವ
ಕತ್ತೆ	ರೆಕ್ಕು		
ಮಣ್ಣು	ನಮ್ಮು		
ಬಟ್ಟೆ	ಟೆಬ್ಬ		
ದೆವ್ವ	ವದ್ದ		
ಕಲ್ಲು	ಲಕ್ಕು		

ABSTRACT WORDS

WORDS	NONWORDS
ಕೂಗು	ಗೂಕು
ದಾವ	ಲಾದ
ದಾಟಿ	ಟಾದಿ
ಕೂಡಿ	ಡೇರು
ಬೇಗ	ಗಾಬೆ
ಹಾಗು	ಗಾಹು
ತೆಗಿ	ಪತಿ
ತಿಳಿ	ಳತಿ
ತೋರಿ	ನೋತಿ
ಕಾಡಿ	ಡಾಕಿ
ಕೋರು	ರೊಕು
ಕಾಸಿ	ಸಾತು
ಕುಡಿ	ಡಿಕು
ಕೇಳು	ರೇಕು

WORDS	NONWORDS
ಪ್ರೀತಿ	ತ್ರೀಪಿ
ಜ್ವರ	ಸ್ವಾಜ
ಕ್ಷಮೆ	ನೈಕ
ಕ್ರೂರ	ಗ್ರಾರು
ಕ್ರಾಪು	ಗ್ಲೂನೆ

WORDS	NONWORDS
ಸಿಕ್ಕಿ	ಕಿಸ್ಸಿ
ಕದುಂ	ದುಕ್ಕ
ರೆಕ್ಕ	ಕೆಲ್ಲ
ಕದಂ	ದಕ್ಕ
ಸುತ್ತಿ	ತಿಸ್ಸು
ಕದುಂ	ದೆಕ್ಕು
ತಟ್ಟಿ	ಟತ್ತಿ
ನಕ್ಕು	ಡನ್ನು

WORDS	NONWORDS
ಸ್ಪಷ್ಟ	ಸ್ವಷ್ಟ
ಪ್ರಾಡ್ಯ	ಡ್ಯಾಪ್ರ
ವ್ಯಾಜ್ಯ	ಜ್ಯಾವ್ಯ

SPECIAL GROUP (A)

ಕಂತೆ	ಕತ್ತೆ	ಕಂಕೆ	ಕೆಕ್ಕೆ
ಕಂದ	ಕದ್ದ	ಡೆಂಕ	ಡೆಕ್ಕ
ಲಂಕ	ಲೆಕ್ಕ	ಕಂಗ	ಕೆಗ್ಗ
ಕೆಂಪು	ಕಪ್ಪು	ಪೆಂಕು	ಪಕ್ಕು
ಮುಂದು	ಮುದ್ದು	ದುಂತು	ದುತ್ತು
ಗಂಡ	ಗಡ್ಡ	ಡಂಗ	ಡಗ್ಗ
ತಂಪು	ತಪ್ಪು	ಡುಂಗ	ಡುಗ್ಗ
ಗುಂಡ	ಗುಡ್ಡ	ತುಂಕ	ತುಕ್ಕ
ಕಂತು	ಕತ್ತು	ಥಂಕಿ	ಠಕ್ಕಿ
ಕಂಠ	ಕಟ್ಟ	ಡಂದ	ಡದ್ದ
ದಂಡ	ದಡ್ಡ	ಬಿಂಪು	ಬಿದಿಪ್ಪು
ಬಿಂದು	ಬಿದ್ದು	ಜತಿ	ಜತ್ತಿ
ಹಂಚಿ	ಹಚ್ಚಿ	ಪಂತು	ಪತ್ತು
ಕೆಂದು	ಕದ್ದು	ದುಂದ	ದುದ್ದ
ಸಂದು	ಸದ್ದು	ದುಂಸ	ದುಸ್ಸ

(SPECIAL GROUP 3 WORDS)

ಕರ್ಮ	ಕರ‍್ಮ
ಚರ್ಮ	ಚರ‍್ಮ
ಕಲಾರ್ಮ	ಕಲಾರ‍್ಮ
ವರ್ಣ	ವರ‍್ಣ
ಅರ್ಪಣೆ	ಅರ‍್ಪಣೆ
ಕುರ್ಚಿ	ಕುರ‍್ಚಿ
ಧರ್ಮ	ಧರ‍್ಮ
ಕರ್ಕಶ	ಕರ‍್ಕಶ
ಕೀರ್ತಿ	[illegible] ಕೀರ‍್ತಿ
ಮೂರ್ತಿ	ಮೂರ‍್ತಿ
ಕಾರ್ಯ	ಕಾರ‍್ಯ
ಸ್ಫೂರ್ತಿ	ಸ್ಫೂರ‍್ತಿ
ಅರ್ಪಿತ	ಅರ‍್ಪಿತ
ಕಾರ್ಮಿನೆ	ಕಾರಮಿನೆ
ಸರ್ಪ	ಸರ‍್ಪ

(SPECIAL GROUP B NW)

ಮೆರ್ಕ	ಮೆರ್ಕ
ಮರ್ಜ	ಮರ್ಜ
ಮೆಕರ್ಲ	ಮೆರಲ್ಕ
ನರ್ವ	ನರ್ವ
ಪರ್ನಣಿ	ಪರ್ನಣಿ
ಬಿಕರ್ಲ	ಬಿರಲ್ಕ
ಮರ್ಧ	ಮರ್ಧ
ಕರ್ಯಕ	ಕರ್ಯಕ
ತೀರ್ಕಿ	ತೀರ್ಕಿ
ತೀರ್ವ	ತೀರ್ವ
ಯಾರ್ಕ	ಯಾರ್ಕ
ಸ್ತೀಪರ್ಲ	ಸ್ತೀರಲ್ಪ
ಪರ್ತಿನ	ಪರ್ತಿನ
ಕಾನೆರ್ಕ	ಕಾನೆರ್ಕ
ಪರ್ಸ	ಪರ್ಸ