READING KANNADA SYLLABLES

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Reaction times for reading Kannada syllables were found for adult subjects. It was possible to vary the number of phonemes and the number of critical visual features representing phonemes independently to a certain extent. It was found that both of them influence the processing speed of syllables. Phonemes seem to affect the processing time more than the number of visual features that they are represented by.

Reading is an intriguing process. Words are found to be read by different processes. They can be read by word specific lexical access or by the grapho-phonemic route (.or by an orthographic route also). Henderson (1982) presents this as Horse race model, in which the stimuli are input to two channels. Non-words fail at lexical search stage and so can only be fully processed by the non-lexical channel. Words are processed through an articulatory representation by both channels. Involvement of phonological processes in either way of processing is also supported by the findings of Tzeng and Wang (1983). They found that even in reading Chinese logographic script phonological processing is involved.

Thus it can be stated that, in any script (visual aspect), reading involves recoding into speech (phonological aspect). However, there seem to be different aspects of the scripts influencing reading. It has been claimed that syllabic sciipts are advantageous in reading (Makita, 1976). Nevertheless this has been questioned (Stevenson, Stigler, Lucker and Lee, 1982). It is possible that the syllabication provides easy access to phonological processing and parsing and thus is advantageous. Even in alphabetical scripts word identification is mediated by segmenting words into syllables (Spoehr and Smith, 1975).

Further, it has been found that it is not the syllables but the number of phonemes in the syllables that will contribute to the ease of syllable identification (Spoehr, 1978). Letter length effects have been found in naming tasks, but not invariably, and is absent in lexical decision tasks (Henderson, 1982).

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Reading Kannada Syllables

The language Kannada permits the writing of different consonant vowel combinations (CV, CCV, CCCV and CCVC in some cases). Whereas in an English syllable letters are written left to sight almost each one representing a phoneme, in Kannada a syllable is a unit visually having a consonant ligatured with a vowel and consonants.

It is reasonable to think that processing a Kannada syllable can be different than processing an English syllable. A Kannada syllable is given readily parsed in print and phonetically regular. For example, America is written ಅಮೆರಿಕ. It is however not a pictorial representation, its components are represented by different cirtical visual features (CVFs) by ligaturing or written adjacent to a consonant. A syllable can have as many or less/more number of CVFs as the number of phonemes in it. The number of visual features is not perfectly correlated with the number of phonemes. For example two phonemes may be represented by 1, 2, 3, 4 or 5 visual features. Also three features may represent 2. 3 or 4 phonemes.

In this study it was intended to see if an adult Kannada reader's processing of a syllable depends on the number of CVFs or the number of phonemes in the syllable.

Methodology

A matching task was used. Posncr and Mitchell (1967) have found that subjects could match the letters 70 m.secs. faster when they were physically alike (AA) than when only the names were alike (Aa). It is said that physical matching is not influenced by the name of the letters. When they are alike subjects can base their decision of matching other than on a verbal code. Posner *et al.* (1969) suggested that subjects can generate the visual information for the given auditory stimuli in the matching tasks and the subjects will be as efficient as they would be in a physical matching task.

It is presumed that when a subject is given the auditory syllabic he generates the visual features to be matched to the visually presented syllable. This will not be equal to the visual matching task. The subject needs to generate and match all the CVFs. Particularly when she/he has to respond negatively 50% of the time when the features presented are very similar but not the same, she needs to match features to features. For example " kha " ಖ to match ' khi ಖಿ Schematically the task is as the following.

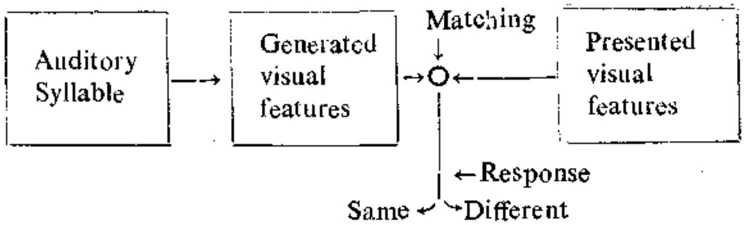

FIG. 1. Scheme of the experimental task of reading.

A prediction can be that it will take longer to match syllables with more CVFs than syllables with less CVFs provided the number of phonemes are the same in them.

Another prediction can be that it will take proportionately longer to process syllables with increasing number of phonemes.

There may be an interaction of the number of phonemes and CVFs.

***Stimuli*:**

The subjects were to match the stimuli, an auditory one to the visual one.

Auditory Stimuli :

These were syllables with varying numbers of phonemes. Half of them were the same as those of the visual ones. The other half were constructed to be very similar to the visual ones but not the same. For example " Kha " ಖ (auditory) to match with " Khi " ಖಿ (visual).

Visual Stimuli :

These were the syllables which were listed on the basis of a systematically varying number of phonemes and the CVFs. Table I presents the list of the syllables. These syllables were selected on the basis that they commonly occur in the print and are not illegal combinations of the features. These syllabled were printed on 6" x 4" cards, in the centre, covering an area of 1 square inch. They were legible and thick enough to be easily perceived.

TABLE I. Syllables with varying number of phonemes and Critical Visual Features

Critical Visual Features \ Phonemes	1	2	3	4	5
1	ಅ ʌ	ಲ lʌ			
2		ಕ kʌ	ಟಂ ṭʌm		
3		ಗು gu	ಮ್ಮು mm	ಟ್ರಂ ṭrʌm	
4		ಕೊ ko	ದ್ರು dru	ಕ್ಷ್ಮಿ kṣmi	
5		ಧೊ dho	ನ್ಯೂ nyu:	ಕ್ರೀಂ kri:m	
6			ದ್ರೊ dro		ಸ್ತ್ರೀಂ stri:m
7				ಡ್ರೋಂ ḍro:m	

Instrument

A Gerbands Tachistoscope was used for the presentation of the visual stimuli. The Tachistoscope was fitted with a timer so measure the reaction time for the stimuli. The switch for the presentation would be put on by the experimenter which would also set the timer on. The subjects were asked to press a switch for having matched the stimuli which would terminate the visual presentation and also stop the timer.

Subjects :

Subjects were adult Kannada readers who were fluent in reading Kannada. Subjects had been reading Kannada through their matriculation formally in schools. There were five subjects.

***Procedure* :**

The subjects were instructed that they would be presented with a syllable orally and after that they would be seeing a syllable (actually " letter " in Kannada) on the screen. They were asked to press a switch provided at their left hand if the presented syllable was the same as the one heard, and to press the right hand switch if the presented letter was not same as the one heard. They were requested to be as fast as possible.

The subjects were seated comfortably to view the screen in the Tachistoscope. The subjects were presented with the oral syllable. To make it precise they were also told a word in whose context it would occur. After that the card was slid to the screen and the experimenter switched on the visual presentation. The subjects responded by pressing either switch which stopped the timer. The experimenter noted the Reaction Time (RT) and whether the response was 'same' or 'different' by the green or red light respectively which would come on the instrument.

The subjects were given feedback whether the response was correct or not and if it were slow or fast.

There were 30 stimuli which could be responded as same and 30 which could be responded as different. These were presented in a random order.

Results and Discussion

On an average the subjects were faster in responding to the same stimuli than the different stimuli. For example if they took 612 m.secs. for the same response it was 667 msecs. for the different response. However the difference was not a consistent one. Processing syllables, whether same or different, could not have been easier as bath would involve either or both of the CVFs or phonemes. It is believed that the presence of equal number of same and different stimuli in a random order forced subjects to be critical in their responding.

Reaction times for various stimuli presented are given in Table II. This table is in the format of Table I. The numbers in rows are the RTs for increasing number of phonemes and those numbers in columns are for CVFs. The numbers in the table present the difference in milliseconds from the average RT for the category. The negative numbers show the faster RTs and the positive slower RTs compared to the average. One can notice that the RT increases with increasing number of phonemes and CVFs.

TABLE II. Reaction Time for Syllables with varying phonemes and CVFs

Critical Visual Features	1	2	3	4	5	Averages
1	— 75	— 144				— 109
2		— 138	· 143			— 140
3		— 100	· 90	+ 89		— 33
4		— 44	+ 2	— 2		— 14
5		— 9	+ 116	+ 69		+ 58
6			+ 2		+118	+ 60
7				+ 63		+ 63
Averages	— 75	— 87	22	+ 54	+ 118	m secs.

Figure 2 presents the RTs for phonemes graphically. It is observed that with increasing number of phonemes to be processed in a syllable there is an increase in RT. Processing up to three phonemes in a syllable has taken less than average time compared to four and five phonemes, This finding is essentially similar to that of Spoehr (1978). She had found that accuracy of reporting a five phoneme syllable was 76% and that for a four phoneme syllable was 80%. Here in this case it is true of speed.

In this experiment it was possible to hold the number of CVFs Constant and still vary the number of phonemes. It is confirmed by the data presented in Table III that even holding the CVFs constant *it* takes increasingly longer to process increasing number of phonemes in a syllable.

TABLE III. Reaction Time for different number of Phonemes holding the Critical Visual Features constant.

CVFs	Phonemes	RT. in m.secs
I CVF	1 Phoneme 2 Phonemes	-75 -144
2 CVFs	2 Phonemes 3 Phonemes	-138 -43
3 CVFs	2 Phonemes 3 Phonemes 4 Phonemes	-100 -90 + 89
.4 CVFs	3 Phonemes 3 Phonemes 4 Phonemes	-44 + 2 - 2
5 CVFs	2 Phonemes 3 Phonemes 4 phonemes	- 9 + 116 + 69
6 CVFs	3 Phonemes 5 phonemes	**+ 2** + 118

It should be noted that the items having two phonemes in them were the fastest to be responded. This could be because of the syllabic structure of the language. Consonant vowel combination has the most frequent occurrence in Kannada. Thus it can be seen that these items were responded to almost twice as fast as to single phoneme items.

The number of CVFs seem to be equally influencing the processing time of syllables. Figure 3 presents the averages of RTs for syllables having different numbers of CVFs in them. It can be seen that processing upto four CVFs take less than average RT but more than that number take more time. As it was possible to hold the number of phonemes constant in a syllable, the effect of increasing number of CVFs could be observed. As presented in Table IV the

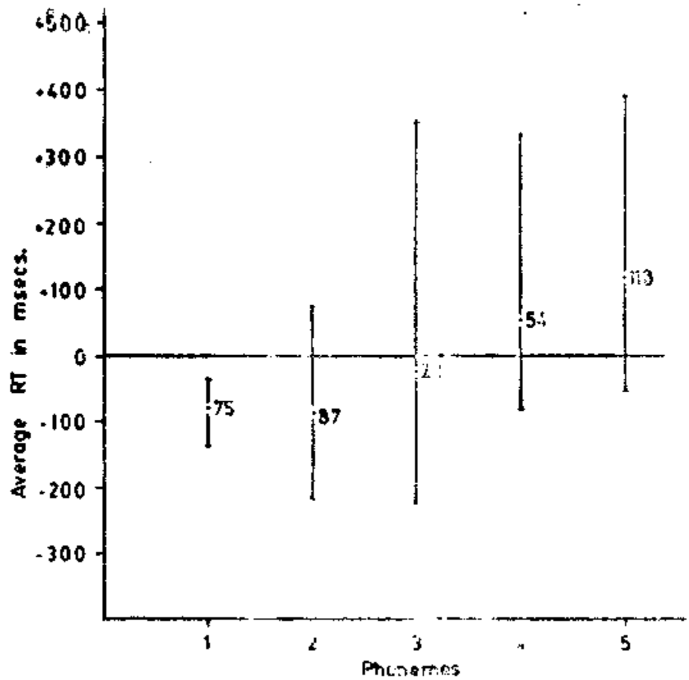

Fig. 2

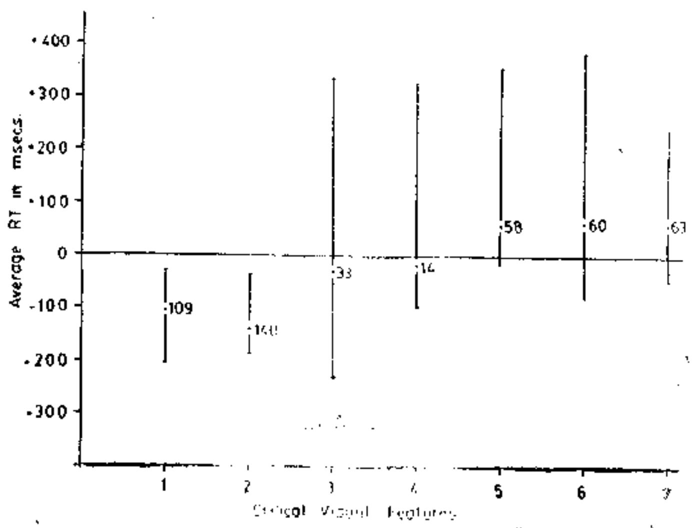

Fig. 3

trend can be seen that the number of CVEs contribute to the processing time of syllables. That is in Kannada syllable processing the visual density (as syllable length in English) contributes as much as phonemes.

TABLE IV. Reaction Time for different number of Critical Visual Features holding the number of phonemes constant

Phonemes	...CVFs	RT in m.secs.
1 Phoneme	1 CVF	—75
2 Phonemes	1 CVF	-144
	2 CVF	...138
	3 CVF	— 100
	4 CVF	- 4 4
	5 CVF	-9
3 Phonemes	2 CVF	-43
	3 CVF	— 90
	4 CVF	+ 2
	5 CVF	+ 116
	6 CVF	+ 2
4 Phonemes	3 CVF	+89
	4 CVF	— 2
	5 CVF	+69
	7 CVF	+ 63
5 Phonemes	6 CVF	+ 118

It can be stated with high certainty that in reading Kannada syllables the contents—phonemes and CVFs—are both important. Also there is interaction of these two factors which is obvious of the phonetic script.

The predictions made earlier seem to hold good with these findings. However, there seems to be a predominant effect of the number of phonemes in a syllable as compared to that of the critical visual features that represent those phonemes in reading a syllable. The results on regression support this. The time needed to process each phoneme in addition (53 m.secs.) is more than that required to process an additional visual feature (36 m.secs.).

It is important to note the shortcomings of this study. Though the stimuli—syllables—were common and familiar, it would be proper to account for their frequency of occurrence when possible. Study could be more extensive.

It would be interesting to have children who are learning to read, as subjects. Also subjects with reading difficulties may exhibit different trends in this kind of studies.

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