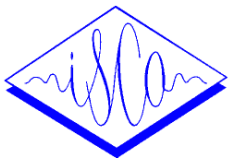

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EXPERIMENTS ON THE SYLLABLE IN HINDI

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ABSTRACT

This paper reports the results of two experiments testing aspects of the syllable in Hindi. The first experiment provides support for the universality of the 'onset-first' principle of syllabification proposed by phonologists for intervocalic single consonants. However, the data do not support this principle in the case of intervocalic consonant clusters. A second experiment explored claims regarding the internal structure of the syllable. Subjects showed no preference between an 'onset-rhyme' (C-VC) division vs. a 'head-coda' (CV-C) division, suggesting that the organization of the syllable in Hindi might be 'flat'.

INTRODUCTION

It is an issue in phonology, psycholinguistics, and spoken language processing whether there is any phonetic structure between the sentence and the segment, e.g., phrase, word, foot, syllable. The syllable, for example, is claimed to be a unit in whose domain rules for segment durations and word stress may be conveniently stated. In this paper I report attempts to evaluate the applicability to Hindi of posited universal tendencies in syllable structures by conducting psycholinguistic tests with native speakers of Hindi. Two claims were tested:

A. The "onset-first" principle dictates that medial consonant(s) is (are) grouped with the following vowel when making syllables as long as this results in a sequence that is a "legal" word onset [1,2].
B. Syllables have been posited to have a hierarchical (as opposed to flat) structure with the division being 'onset rhyme' (OR) rather than 'head coda' (HC) [6, 11]. Thus the structure is posited to be as in (a), not as in (b) or (c) in Fig. 1.

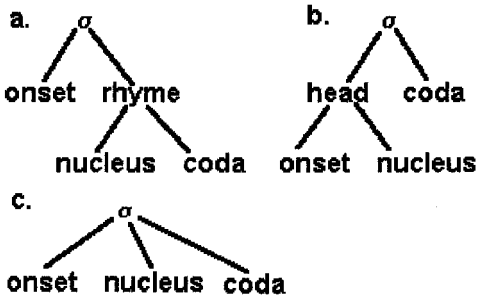

Fig. 1 Three possible structures internal to the syllable.

EXPERIMENT 1

The first experiment addressed the following two questions: (a) Do intervocalic single consonants syllabify with the following or the preceding vowel, i.e., V-CV or VC-V? (b) For intervocalic sequences of two consonants, is the break V-CCV, VCC-V, or VC-CV?

The 'onset-first' principle referred to above would dictate that as long as the phonotactic constraints are not violated, the syllable break should maximize onsets and thus be V-CV for single consonants and V-CCV for clusters of two consonants. (This is a slight simplification since variables such as the 'sonority hierarchy' etc. are also taken into account [1, 13, 14]).

Procedure

I addressed the issue of syllable demarcation using the 'pause-break' experimental paradigm developed by Derwing [3]. In this paradigm subjects are presented with different alternatives for syllabifying the word and asked to choose one. Thus, to use an English example, for the word *melon* one would present them with *me-lon, mel-on,* and *mel-lon.* (This last option treats the [l] as ambisyllabic, i.e. belonging to both syllables. However, I omitted the ambisyllabic choice since a pilot study showed that subjects never used it.)

I presented the words orally to 36 native speakers of Standard Hindi (all also knew English). The subjects were all from New Delhi, India. They were told the purpose of the experiment was to determine hyphenation for Hindi (as would be required in written texts, for example). I read the words (I am a native speaker of Standard Hindi) with different pause breaks and the subjects circled their preference on a sheet provided to them which simply had the word number and (a) (b) and optionally (c) (the choice (c) was relevant to words with two consonant clusters to be discussed shortly). Thus they never saw the word of interest in written form. In reading the words with the different pause break choices I varied the choice, i.e.sometimes V-CV would come first and at other times VC-V.

In the case of intervocalic single consonants, 24 real words were chosen. Since earlier studies by Treiman et al. [14] had found that the nature of the consonant (liquid, stop, etc.) might effect syllabification, 12 of the words in my list involved liquids and the other 12 stops (voiced and voiceless). Thus, examples were of the following type:

(1)	[tɪlək]	'mark on forehead'	[bədən] 'body'
	[malɪk]	'master'	[kʰadi] 'type of cloth'
	[čela]	'disciple'	[čʰɪpa] 'hidden'
	[šərab]	'liquor'	[hatʰi] 'elephant'
	[zira]	'cumin'	etc.

In the case of intervocalic consonant clusters the 'pause-breaks' were as follows: VC-CV, V-CCV, VCC-V. Eleven words were used and these represented the following types: stop + glide, stop + liquid, fricative + glide, fricative + nasal, and

fricative + stop. (Homorganic nasal + stop clusters and geminates were not included.) (2) lists the words used. (The numbers in the rightmost column will be discussed shortly.)

(2) *Word responses*		*Ratio of VC-CV*
[əkhrot̪]	'walnut'	.92
[čəkla]	'round platter for rolling dough'	.92
[bəkwas]	'nonsense'	.92
[čaplus]	'flatterer'	.89
[rɪšwət]	'bribe'	.83
[čəšma]	'spectacles'	.81
[təštəri]	'platter'	.78
[išwər]	'god'	.78
[səsta]	'cheap	.78
[kɪsmət]	'fate'	.75
[vɪdya]	'knowledge'	.69

In all but two cases a V-CCV break would yield possible initial clusters (the exceptions are *kʰr-* and *št-*). Similarly in all but two cases a VCC-V break yielded acceptable final clusters (the exceptions being *-kʰr* and *-pl*). For a detailed account of Hindi phonotactics see Ohala [8].

The words were randomized into two different orders; approximately half the subjects heard the words in one order and the other half in reverse order. There was an initial training session where words not used in the main test were presented to subjects with the possible 'pause-break' choices. Once subjects mastered the task the main test was given.

Results for Intervocalic Single Consonants

The overwhelming response in the case of intervocalic single consonants was to syllabify the medial consonant with the following syllable thus supporting the 'onset first' principle (the ratio was .72, $\chi^2 = 173$, df = 1, $p << .001$). The only exception was the word [šərab] 'liquor' where the incidence of V-CV responses was only .42. I have no explanation for this. There was no difference found depending on whether the consonant was a liquid or stop.

Discussion

This overwhelming preference for the intervocalic consonant to go with the second syllable is interesting because this was *in spite of* the fact that in some cases Hindi MSC's were violated in that Hindi does not permit short vowels such as [ə] and [ɪ] in word final position and thus presumably also syllable final. Possible influence from orthography needs to be discussed. The Hindi orthography, Devanagari, has some characteristics of a syllabary. Thus, the initial CV in a word like [kɪla] 'fort' is represented by a single symbol with diacritic marks for vowels; if no other vowel's diacritic is present, a schwa is assumed. If the intervocalic C is parsed with this initial syllable the following [a] would have a different shape (since now it is syllable initial) than if it is parsed with the second syllable yielding [-la] and perhaps this led to more V-CV judgements. Although subjects were presented the words orally it is always possible that they were accessing some mental orthographic representation before responding.

Results of Intervocalic Consonant Clusters

Subjects overwhelmingly preferred to syllabify between the two consonants, i.e., VC-CV. The incidence of this response was .82 ($\chi^2 = 166$, df = 1, $p << .001$) for all 11 words. The rightmost column in (2) gives the ratios for the individual words. Thus regardless of the existence of a particular cluster as word initial or final, and regardless of whether it occurred in native or loan vocabulary, the syllabification was between the two consonants.

Discussion

Such VC-CV syllabification also goes against the proposed 'onset first principle' including versions of it which take the sonority values of segments into account such as Clements' 'core syllabification principle' [1]. For example, a word such as [čaplus] 'flatterer' should be syllabified as [ča-plus] according to these principles since [a] is a possible coda and [pl] a possible onset and such a division would obey Clements' proposal that "...intervocalic clusters be syllabified in such a way as to both maximize the length of the syllable onsets and increase the difference in sonority between their first and last members [pg. 300]". However, subjects' overwhelmingly preferred a division between the two consonants.

It is also interesting to note that the results of both parts of this experiment match those reported for other languages by Derwing [3]. They also match the ones reported by Sherzer [12] for Cuna based on a word game played by children involving syllable movement. This word game showed subjects divide VCV as V-CV (similar to my findings reported in experiment '1A' above) and VCCV as VC-CV.

Even though the words were presented to subjects orally, once again the possibility of orthographic influence has to be discussed. There are two ways that the first consonant in the medial cluster can be represented. First, it can be represented with a full (canonical) symbol which by itself stands for a consonant and a following schwa (since Devanagari is a quasi-syllabary). However, in the above words this schwa would not be pronounced because the spelling-to-sound rules -- specifically, a form of schwa-deletion rule -- would delete it. Thus these rules would yield the clusters in the words in (2). (For details of the schwa-deletion rule, see Ohala [8].) Alternatively the first consonant can be written with a half symbol attached to the next consonant; this is an overt indicator of a cluster. Although for most words which of the two alternatives will be taken is fixed (dictionaries reflect this and students are taught the appropriate symbolization in Hindi classes), there is some variation and the average native speaker reflects the same type of insecurity as English speakers do for the spelling of a number of words of their language. In the case of the words given in (2), the first four are written with the first consonant represented with the full symbol (i.e. as *Cə*), the next five with the first consonant written as a half symbol. The second-to-last word [kɪsmət] can be written either way (according to Varma [15]). And the last word [vɪdya] has a very special symbol for the *-dy-* cluster -- the orthographic equivalent of suppletion. In the case of words written with the first consonant of the -CC- having a full symbol, e.g., [čaplus], if subjects were influenced by orthography they should prefer the VC-CV break not the V-CCV break predicted by the onset-first principle. The reason for this is if they conceived of the division V-CCV there would be no way the phonetic medial cluster could be derived because the orthographic schwa deletion rule does not apply to morpheme initial syllables. (Although the [-p-] is not really morpheme initial, making it syllable initial gives it initial status.) Making the [p] syllable final, as a VC-CV break would do, avoids this problem. However, this problem is not involved for the rest of the words in which the first consonant

is written using the half symbol. Nevertheless it is interesting to note from the ratios given for each word (in the rightmost column of (2)) that the highest ratios of VC-CV responses were for the [ʧaplus] type words and the lowest for [vɪdya] which, as mentioned above, involves a very special symbol for the cluster. Thus the dominant VC-CV response could be said to be partially modulated by orthographic influence. The alternative explanation of course is that subjects' preference for VC-CV reflects the psychologically real phonological structure of words (distinct from the orthographic structure).

EXPERIMENT 2

The next experiment addresses the question of whether there is internal structure to the syllable, and if 'yes', then is the major break between head and coda (HC) or between onset and rhyme (OR) (see Fig. 1).

If orthography is either influenced by mental organization or, instead, itself influences mental organization, one might expect Hindi speakers to prefer the HC division because Devanagari symbols are syllable based (i.e. CV). To address this question I used a slightly modified version of an experimental paradigm involving blends developed by Derwing and his associates [4,5]. (My modifications involved including a 'foil' to check subjects for internal consistency. Details are included below.)

Procedure

Subjects were presented orally with a pair of words such as [mʊlk] 'country' [ʧand] 'moon' and given the choice of two blends: (a) [mand] (b) [mʊnd]. The first is formed by taking the onset of [mʊlk] and the rhyme of [ʧand]; and the second by taking the head of [mʊlk] and coda of [ʧand]. Ten such word pairs were used, five involving word final clusters (as in the example given above) and five with a CVC structure. The words were all real words. They were nouns or adjectives and the word pairs did not violate any 'parts of speech' constraints. The resulting blends were nonsense words in all but one case. (The exception is [mʊlk] + [ʧand] where [mand] and [mʊnd] are both existing words; the former means 'trough' and the latter 'dim-witted'.) The blends all conformed to the phonotactic constraints of Hindi. The word pairs were also balanced for the character of the initial consonant. Thus the pairs involved stop + stop/nasal/[r], fricative/affricate + nasal, nasal + stop/affricate/fricative, r + stop. Each word pair was presented twice during the course of the experiment with the order changed. Thus the first time the subjects might get [mʊlk] [ʧand] and the resulting choice of the two blends as given above and some time later [ʧand] [mʊlk] with the choice between [ʧalk] (HC) or [ʧʊlk] (OR). Also, for a word pair, if the first presentation involved the OR blend being given as choice (a), the next presentation would have the HC blend as choice (a). There were two types of 'foils' included. (1) In order to make sure subjects were following the assigned task, some choices involved a non-blend. It was expected that subjects would reject the unblended member. (2) In order to check for internal consistency (i.e. that subjects answered the same way the second time also, thus demonstrating internalized rules) a few items were repeated (with no changes). In all 28 tokens (the 10 pairs of words, their repetitions, and the foils) were presented orally to 38 subjects (36 of whom were the same as for experiment 1). There were two different randomizations of the word list. Half the subjects received one and the other half the other. The subjects checked their preference for the blends on a answer sheet provided to them (which had "a" or "b" for the first or second token heard--the actual words or blends were not printed on the answer sheet). There was a training session (with word pairs not included in the main test) which also included an unblended token (i.e. a 'foil') and if subjects chose that they were reinstructed (since their instructions were to choose between two blends). To make the task believable subjects were told that often companies need to make up new words for products and one way they do this is by making up a blend. The English loanword *motel* had to be used as an example because Hindi does not have any blends -- at least none that I could think of as clear examples (i.e. this is not a very common word formation process). I also gave a hypothetical example of a new soft drink which is made of mixing mango juice with a native drink made of fermented carrots and spices, i.e., *mango* + [kaɲji] 'a drink made of fermented carrots' being called [maɲji]. I told them I was seeking their preference between pairs of blends.

Results

If we look at the results for all 38 subjects the total number of responses were 836. Of these 433 were HC and 403 OR. The difference is not significant ($\chi^2 = .75$, df = 1, $p > .25$).

As mentioned above there were two types of 'foils' in the design of the experiment, one to check if subjects were consistent in their responses and the second to demonstrate that they understood the task by not choosing an unblended token. I next examined the results to weed out subjects who failed these criteria. A question comes up as to how many errors a subject can have on these 'foils' and be retained in the pool (assuming that a few errors could occur by chance). I arbitrarily decided that of the three 'repeats', if they erred more than once they were excluded from the pool. Furthermore, of the six opportunities for choosing an unblended words, if they erred three times or more they were excluded. This left me with a pool of 23 subjects. Their results are as follows: the total number of responses were 506. Of these 270 were HC and 236 OR giving a ratio of .47 and .53 respectively. Once again the difference is not significant ($\chi^2 = 2.29$, df = 1, $p > .10$) and fairly similar to the results of all 38 subjects. I also looked at the results broken down by whether the words involved clusters or were CVC. This did not turn out to be a contributing variable. Nor did it matter what type of consonants were involved, e.g., stop + stop, nasal + stop, etc (as mentioned above the design of the test words was sensitive to this).

Finally I looked at the results of only those subjects who made *no* mistake in any of the 'foils'. 11 subjects satisfied this criteria. Of the 242 responses given by them 130 were HC and 112 OR which gives a ratio of .46 for the former and .54 for the latter. These results are again not significant ($\chi^2 = .81$, df = 1, $p > .25$) and similar to the ones given above.

Discussion

Thus the subjects did not choose HC as might be predicted by the orthography nor did they choose OR as native speakers of English do. There are three possibilities regarding the interpretation of these results:

1. The subjects are giving the right answers and their responses show that some people have a preference for OR and others for HC and that they are equally divided in the population. Thus we are getting at the phonological structure of Hindi in *individual* grammars. If this is the correct analysis, the results should show a bimodal structure. I examined the

results of all 38 subjects as group and then those for the group of 23. There was no bimodal pattern. The results of the group of 11 may look slightly more bimodal but the numbers are so few that it is difficult to be definitive. So this possibility has to be rejected.

2. The structure of the syllable in Hindi is flat (not hierarchical) and thus the question addressed by the experiment doesn't have any meaning for the subjects. The great variation in subjects' responses was a reflection of this.
3. The test didn't test what it sought to because the task of judging blends was unreasonable (or the instructions were unclear, or subjects had memory limitations). This might indeed be a possibility since, as mentioned earlier, Hindi doesn't have very many existing words which are blends. Thus perhaps the experimental paradigm used was unsuited for a language like Hindi.

At the present time I do not have any basis for choosing between the alternatives mentioned in (2) and (3).

Thus, certainly for this experiment subjects' responses did not match those predicted by a syllabic writing system such as the ones for Korean and Japanese [4, 7]. However, Hindi differs from Japanese in some interesting ways which might be relevant here. Although, like Japanese, Hindi uses a syllabary, unlike Japanese it does not have word prosody. (In Ohala [9] I provide some evidence for my claim that Hindi does not have word stress.) Kubozono [7] attempts to link the HC preference in Japanese to the 'mora' and Japanese prosody. Additionally he claims that Japanese spoonerisms also provide evidence for HC; Hindi speakers do not make spoonerisms [10]. Could there be a link between the lack of word stress, lack of spoonerisms, and subjects' lack of preference for HC or OR in Hindi? At the present time I have no answers to these questions. Further experimentation is necessary.

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