PHONOLOGICAL SIMILARITY EFFECTS IN CANTONESE SPOKEN-WORD PROCESSING

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ABSTRACT

A Cantonese experiment is described in which the shadowing of spoken targets as a function of phonological similarity to either a succeeding prime (backward priming) or a preceding prime (forward priming) is investigated. In the backward priming conditions, alternations of onset, rime, or tone between prime and target produced inhibition, whereas in the forward priming conditions, alternations of tone led to facilitation. The results are discussed in terms of the processing and memory of Cantonese syllables.

1. INTRODUCTION

In the psycholinguistic literature, there has been a considerable interest in the study of the use of lexical stress in word recognition. However, although tone is another prosodic feature by which many languages use to distinguish utterances, very few studies have investigated its role in spoken-word processing.

For example, Taft and Chen [1] found that homophone judgments for written characters in Mandarin were made less efficiently when the pronunciation of the two characters (i.e., monosyllabic syllables) differed only in tone, as opposed to in vowel; a similar pattern of results was found in another experiment in Cantonese. These results suggest that a tone disadvantage may appear when the phonological information of a character is retrieved and used. A similar tone disadvantage has also been found by Cutler and Chen [2], using both lexical decision and syllable comparison tasks; this result was replicated in another experiment with listeners who knew no Cantonese and were native speakers of Dutch using the syllable comparison task. They thus suggest that the tone disadvantage may be due to the limitation of processing at the initial encoding of acoustic stimuli. This perceptual interpretation, however, cannot account for the results reported by Taft and Chen.

The present study aims to examine the processing of tonal and segmental structure in Cantonese. To achieve this, we adopted a shadowing task with both forward and backward priming paradigms. In the forward priming situation, the target of shadowing was the second item of two syllables, whereas in the backward case, the target was the first item. These two priming conditions thus allowed us to investigate both the perception and memory of Cantonese monosyllables.

2. METHOD

2.1 Participants.

Fifty-four subjects were recruited from the introductory psychology subject pool at the Chinese University of Hong Kong. All participants were native speakers of Cantonese, and none reported a history of hearing loss or speech disorder.

2.2 Materials

The experimental stimuli included 40 sets of 5 monosyllables each; all stimuli were existing syllables in Cantonese. Each set of stimuli was formed by a target item such as *cho2*, a phonologically related prime with a distinctive tone (P[T]) such as *cho1*, a phonologically related prime with a distinctive onset (P[O]) such as *do2*, a phonologically related prime with a distinctive rime (P[R]) such as *chi2*, and a phonologically unrelated prime (P[U]) such as *gwa1*. All stimuli were recorded by a female native speaker of Cantonese and digitized at a sampling rate of 22 kHz and stored on computer for presentation.

2.3 Design and Procedure

The design included one between-subjects factor (i.e., priming condition: forward or backward) and one within-subjects factor (i.e., type of prime: onset difference, rime difference, tone difference, or unrelated).

Subjects were randomly and equally divided into two groups, with 27 in each, and were tested individually in a quiet room. They heard the stimuli, in pairs, at a comfortable level through headphones. The subjects were instructed to repeat the target immediately after hearing the two syllables, and to respond as quickly and accurately as possible.

The experiment included a practice session and an experimental session. The experimental session consisted of 40 trials, with 10 trials for each of the four prime types. The order of presentation trials was randomized for each subject individually.

Each trial started with the presentation of a fixation point on the computer screen for 500 msec, followed immediately by two spoken syllables, which were presented one after another with a 250-msec interstimulus interval. Shadowing latencies were recorded from the offset of the second syllable. In the backward priming conditions, subjects heard a monosyllabic target followed by one of four monosyllabic primes. The forward priming conditions were conducted exactly as in the backward conditions, except that targets and primes were presented in reverse order.

Stimulus presentation, timing, and response collections were under the control of a Power Macintosh 7600/132 computer running the PsyScope experimental control program developed by Cohen, MacWhinney, Flatt, and Provost [3].

3. RESULTS AND DISCUSSION

Mean shadowing latencies for correct responses, measured from the offset of the second syllable, and mean error percentages in each condition were calculated for each subject and for each item. Since the shadowing latencies and the error data were generally consistent with each other, only the response results are reported here. The average shadowing latencies as a function of type of prime and priming condition are presented in Table 1.

	Prime Type			
Priming Condition	Onset Diff.	Rime Diff.	Tone Diff.	Unrelated
Forward	382	388	365	388
Backward	456	442	460	418

Table1. Average shadowing latencies (in milliseconds) as a function of prime type and priming condition.

To describe the shadowing data under forward and backward priming conditions, we report two separate analysis of variances conducted across participants and items for each priming condition. In the backward priming conditions, the analyses revealed a significant effect of prime type, $F_1(3,72) = 7.22$, $p<.01$, $F_2(3,40) = 6.07$, $p<.01$. Post hoc tests showed that this prime type effect was due to significant differences between the unrelated-prime condition and the three phonologically related-prime conditions. In other words, in the backward priming conditions, alternations of onset, rime, and tone have exactly parallel effects; all three phonologically related-prime conditions showed inhibition effects. Thus shadowing of a monosyllable in Cantonese is not facilitated, and indeed is inhibited, by a short delay during which a phonologically similar item is heard.

In contrast, in the forward priming conditions, there was facilitation instead of the inhibition observed previously: The effect of prime type was reliable by participants, but it did not approach significance by items, $F_1(3,66) = 2.87$, $p<.01$, $F_2(3,40) = 1.67$, $p>.05$. However, post hoc tests showed that a significant facilitation effect was only observed when the difference between target and prime occurred in tone. Thus shadowing of a Cantonese monosyllable appears to be facilitated by having just heard another monosyllable having the same segmental structure.

What do our results obtained under different priming conditions tell us about the perception and memory of Cantonese syllables? First of all, it seems like the subjects in our experiment were paying attention to both segmental structure and tonal information and were processing these different aspects of a syllable as soon as the syllable was heard. Therefore, in the backward priming conditions, alternations of any aspect of syllabic components between prime and target produced significant inhibition. This finding is in line with recent results from other experiments conducted in our laboratory on the topic using

different tasks (Chen, Yip, & Wong [4]; Cutler & Chen [2]). However, our pattern of results in the forward priming conditions suggests that the memory of tonal information may not be as good as the memory of segmental information. Thus alternations of tone in the backward priming conditions led to facilitation, but no facilitation was found with alternations of onset or rime. This facilitation effect actually parallels reported results in forward priming for repeated items (Radeau, Morais, & Dewier [5]). Moreover, our suggestion that listeners may be less efficient in utilizing stored information of tone than in utilizing stored segmental information is also in line with earlier findings in both Cantonese and Mandarin (Taft & Chen, [1]). We suspect that the disadvantage for the memory of tonal information in comparison with the memory of segmental information is possibly due to the fact that there are tone sandhi rules existed in the language which may make listeners of the language treat tones as potentially unreliable objects.

4. ACKNOWLEDGEMENTS

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5. REFERENCES

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