A PERCEPTUAL ACCOUNT FOR CANTONESE VOCATIVE REDUPLICATION

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ABSTRACT

Both phonological and morphological reasons have been suggested to account for mismatched elements in reduplicative outputs (e.g. *gbóná* is reduplicated as *gbí-gbóná* in Yoruba). However, the mismatched tonal sequences in Cantonese vocative reduplication are not amenable to either account (namely, the Emergence of the Unmarked account and the Morphological Doubling Theory account). This study proposes a third reason – maximizing perceptual similarity in the presence of other prosodic factors. We present the results of a perceptual experiment that support the crucial prediction of the perceptual similarity account - that the two copies in the reduplicative complex have the greatest perceptual similarity among all relevant competitors.

Keywords: perceptual similarity, reduplication, Cantonese tones

1. INTRODUCTION

The focus of this article is on reduplication patterns that show mismatches between the base and the reduplicant. Some have proposed phonological constraints reflecting the Emergence of the Unmarked (TETU) to account for mismatched elements in reduplication [1]. Others have tried to motivate mismatched elements through morphosemantic requirements, such as Morphological Doubling Theory (MDT, [4] [5]). In this study, we propose a perceptual similarity account for the mismatched tonal sequence in Cantonese vocative reduplication. In particular, we argue for two crucial motivating factors for the tonal patterns in Cantonese vocative reduplication: (a) high perceptual similarity of the two tones in a fixed sequence of the reduplicative complex; (b) a language-specific preference for disyllabic iambic patterns. A perceptual experiment is presented to test the similarity account.

1.1. Cantonese vocative reduplication

Cantonese has a rich system of lexical tone contrasts, including six long tones in either open syllables (CV), or syllables with a nasal coda (CVN), and three short tones in syllables that end in oral stops (CVT), as shown in Table 1. The tones code for relative pitch where '5' marks the highest pitch and '1' the lowest [3].

Table 1: Cantonese tones

Syllable type	Tone number	Tone codes	Description
CV or CVN	T1	55	high level
	T2	25	high rising
	T3	33	mid level
	T4	21	mid-low falling
	T5	23	mid-low rising
	T6	22	low level
CVT	T7	5	high-stopped
	T8	3	mid-stopped
	T9	2	low stopped

Patterns of Cantonese reduplicative vocatives display tonal mismatching between the monosyllabic input and the disyllabic output (Table 2). There is an invariant sequence T4 followed by T2 in Cantonese vocative reduplication, except when the source is T1 or T3. This study seeks to investigate the following question: why is there a preference for the fixed T4-T2 pattern in this vocative reduplication?

Table 2: Cantonese vocative reduplication

Input	Output	Examples
T2	T4-T2	zai2 → zai4zai2 'son'
T4		po4 → po4po2 'old woman'
T5		naai5 → naai4naai2 'husband's mother'
T6		dai6 → dai4dai2 'younger brother'
T1	T4-T1	ba1 → ba4ba1 'father'
T3	T3-T2	tai3 → tai3tai2 'wife'

1.2. Previous analysis on mismatches in reduplication

A TETU-based analysis suggests that the fixed tones T4 and T2 are the two most unmarked tones in Cantonese; however, this account is not supported by frequency and loanword patterns since the most frequent tones and default tones in loanwords are T1, T3 and T6 rather than either T4 or T2 [6][10][12].

MDT is an approach to reduplication in which morphological constructions can call for two morphological constituents that only require semantic identity but not necessarily phonological identity. Using this framework, Yu [12] analyzes the Cantonese vocative reduplication as double-stem formation. Such an MDT account regards phonological identity as an epiphenomenon. Thus MDT-based accounts do not make any specific predictions about the phonological identity between the members of the reduplicative complex. Furthermore, the sources of the dominant tones in the MDT accounts seem to be arbitrary in this analysis. Therefore, it is still unclear why the T4-T2 sequence is selected as the optimal output.

1.3. A disyllabic iambic output template

To explain the preference for a low-high tonal sequence, it seems plausible to attribute it to a need for a disyllabic iambic output template in Cantonese vocative formation [11] [12]. Such a disyllabic iambic template, defined as a non-high tone followed by a high tone, can be found in another Cantonese vocative formation in Table 3: the prefixation of *a3-* and *lou3-* to monosyllabic names, leading to a change to T2 on the final syllable. The need for a disyllabic iambic vocative constrains the first syllable to have a non-prominent mid/low tone (i.e. T3, T4 or T6), and the second syllable to have a high tone (i.e. T1 or T2) in the reduplicative complex. However, this iambic requirement alone cannot explain why T4 and T2 are selected to form the optimal mismatched output in reduplicative complexes, since it does not exclude other low-high sequences. (Note: T3 appears frequently in non-reduplicative vocatives).

Table 3: Cantonese non-reduplicative vocative formation [11] [12]

Monosyllabic name	After prefixation
yip6	a3yip2
can4	a3can2
wong4	lou3wong2
daai6	lou3daai2

1.4. Previous studies of Cantonese tones

Previous studies [7] [8] have shown that the reaction time needed to discriminate the pair T2|T4 (Note: '|' indicates both AX orders) is longer than other mid/low-high tone pairs in Cantonese, suggesting relative similarity between T2 and T4. However, the experiments have confounds that are crucial to the interpretation of the results. First, it is unclear if the long reaction time for pair T2|T4 is due to the experiment design of the previous studies. For example, the reaction time was calculated from the onset of the second monosyllable in [7] [8]. The long reaction time for pair T2|T4 may be merely due to the similarity of the onsets of T2 and T4. Second, the previous studies did not compare the reaction times to other relevant tone sequences (mid/low-high tones). Third, the participants in the experiment were all Cantonese speakers, who may have been biased by their L1 knowledge.

1.5. A maximum perceptual similarity hypothesis

We propose two crucial motivating factors for the tonal patterns in Cantonese vocative reduplication: (a) high perceptual similarity of T4 and T2; (b) a preference for disyllabic iambic patterns, which requires a low-high tonal sequence in disyllabic vocatives. This hypothesis predicts that the two copies in the vocative reduplication are perceptually similar. In particular, it predicts that the perceptual similarity of T4 and T2 is greater than other combinations of mid/low-high tones that also satisfy the iambic template.

2. EXPERIMENT

This section presents a perception experiment on Cantonese tones to test the prediction made by the perceptual similarity hypothesis.

2.1. Stimuli

One of the authors, a female native speaker of Standard Cantonese, produced the stimuli, which were all attested monosyllabic words in Cantonese (so that the author could produce them naturally). They all had a CV frame (namely, *fu*, *ji*, *jau*, *to*, *wui*) with six contrastive long tones. The recordings were made with a Logitech desktop microphone connected to a Macbook laptop at a sampling frequency of 44.1KHz in Praat [2]. They were selected from the zero crossings at the onset of the initial consonant and the offset of the vowel. The intensity for all stimuli was normalized to 70.0dB.

The crucial test stimuli were all tone pairs that could potentially satisfy the iambic preference, i.e.

all mid/low-high tone pairs. For each CV syllable, there were 6 AB mid/low-high tone pairs (i.e. T1|T3, T1|T4, T1|T6, T2|T3, T2|T4, T2|T6) and 6 AA pairs (i.e. T1|T1, T2|T2, T3|T3, T4|T4, T5|T5, T6|T6). In total, there were 60 AB pairs (5 CV types × 6 pairs × 2 orders) and 60 AA pairs (5 CV types × 6 pairs × 2 repetitions).

2.2. Participants

The participants consisted of fifteen native speakers of American English and fifteen native speakers of Guangzhou Cantonese. The American English participants were undergraduate students from Michigan State University, who had no prior exposure to Cantonese. Five of the Cantonese participants were graduate students from Michigan State University, who have been in the United States for 3-7 years. The other Cantonese participants were undergraduate or graduate students from South China University of Technology and South China Agricultural University in Guangzhou. All participants reported normal hearing.

2.3. Procedure

An AX (same-different) discrimination task was employed to probe the perceptual similarity of the test stimuli. The stimuli were presented randomly to the participants through headphones using the experimental software PsychoPy [9] on a MacBook laptop. The inter-trial interval was 2000ms and the inter-stimulus interval was 1000ms. Participants were instructed to judge whether the two recordings in each trial were the same or not as quickly as they could. They were instructed to press the key 's' for the 'same' responses, and the key 'n' otherwise. There was a short training block before the real experiment. Feedback was given to the participants during the training by the experimenter. Participants were instructed to press the key right after they heard both recordings in a trial. The actual time at which responses were allowed was set to a point that marked nine-tenths of the duration the second stimulus.

2.4. Results

The accuracy rates for both English participants and Cantonese participants were very close to ceiling (all above 85%). However, the reaction time (RT) data for different pairs of stimuli show a different picture (Figure 1, Table 4). The RTs were all log-transformed (LogRT) before any statistical tests were conducted. The effect of tone pair type on LogRT is statistically significant for both linguistic groups (English participants: $F[5,84]=2.654$, $p<.05$*, ges=0.136; Cantonese participants: $F[5,84]=2.450$, $p<.05$*, ges=0.127).

Post-hoc t-tests only analyze comparisons involving the LogRT of T2|T4 and its competitors, for these comparisons are the main interest of the current study. To counteract a multiple comparisons problem, p-values were corrected by Bonferroni correction. The results show that the LogRTs of the pair T2|T4 were significantly longer than the LogRTs of other mid/low-high tone pairs, for both English and Cantonese participants (Table 5).

Figure 1: Mean log-transformed reaction time (LogRT) data for the mid/low-high tone pairs

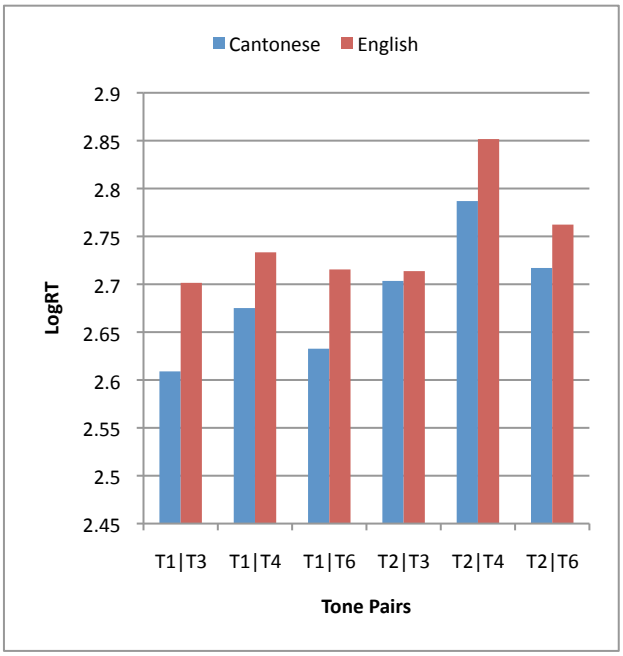

Table 4: Mean log-transformed reaction times (LogRTs) and accuracy rates for both linguistic groups

Participant	Pair	RT (ms)	Log RT	Accuracy
English	T2 | T3	595	2.71	99.4%
	T2 | T4	***774***	***2.85***	96.6%
	T2 | T6	659	2.76	97.7%
	T1 | T3	573	2.70	90.8%
	T1 | T4	644	2.73	94.9%
	T1 | T6	606	2.72	95.4%
Cantonese	T2 | T3	582	2.70	97.2%
	T2 | T4	***661***	***2.79***	98.6%
	T2 | T6	581	2.72	98.0%
	T1 | T3	515	2.61	85.7%
	T1 | T4	563	2.68	97.2%
	T1 | T6	511	2.63	93.8%

Table 5: Post-hoc t-tests for LogRT

Participant	Results of t-tests
English	T2|T4 ~ T1|T3: t(14)=5.893, p<.05*
	T2|T4 ~ T1|T4: t(14)=4.364, p<.05*
	T2|T4 ~ T1|T6: t(14)=6.617, p<.05*
	T2|T4 ~ T2|T3: t(14)=5.621, p<.05*
	T2|T4 ~ T2|T6: t(14)=5.621, p<.05*
Cantonese	T2|T4 ~ T1|T3: t(14)=3.263, p<.05*
	T2|T4 ~ T1|T4: t(14)=3.837, p<.05*
	T2|T4 ~ T1|T6: t(14)=6.047, p<.05*
	T2|T4 ~ T2|T3: t(14)=3.344, p<.05*
	T2|T4 ~ T2|T6: t(14)=3.734, p<.05*

3. DISCUSSION

The results of the perception experiment show that both English participants and Cantonese participants are significantly slower at discriminating the tone pair T2|T4 compared to all other relevant AB tone pairs, which indicates that the pair T2|T4 is more perceptually similar than the other relevant tone pairs. To further investigate any correlation between perceptual similarity and the vocative reduplication, we have also conducted a pilot study to test if perceptual similarity between mismatched copies in a reduplicative complex aids the learnability of reduplication patterns. Preliminary results show a strong tendency for participants (all native speakers of American English) familiarized with reduplicative patterns containing T2 and T4 to be more likely to recall the words than participants who are familiarized with reduplicative patterns containing the other relevant tone pairs, thereby suggesting that reduplications involving T2|T4 are more learnable than other tone pairs.

The perceptual similarity account might have its limitation in explaining cases where the input is T1 or T3. Some other factors may have contributed to the preservation of these tones in the vocative reduplication. First, they are relatively unmarked, based on the facts that they are the first and second most frequent tones respectively [6] [12], and they are the defaults in tonal assignment in loanword adaptation [10] [12]. All these factors may give rise to the preservation of T1 and T3 in the vocative reduplication.

4. CONCLUSION

In this study, we argue that Cantonese vocative reduplication imposes a language-specific prosodic context and demands perceptual similarity between the base-reduplicant. The claim of perceptual similarity has been supported by the results of an AX discrimination experiment. This study provides a new insight of incorporating perceptual similarity into analyses of reduplicative mismatches. More broadly, it adds the importance of perceptual factors to the general literature of phonology.

5. REFERENCES

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