Tonal Perception, Behavioral Studies

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Article Table of Contents

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1. Perceptual Correlates of Tones

There is a wide consensus that fundamental frequency (F0, which is determined by the rate of vocal fold vibration) is the major acoustic correlate and the primary perceptual cue of lexical tones in both Cantonese (Fok-Chan 1974) and Mandarin (Howie 1976). Native listeners, however, weigh the perceptual dimensions differently. Gandour (1984) found that while both F0 height and F0 direction are important perceptual dimensions of tones, Cantonese listeners attached more importance to F0 height (see also Vance 1977), while Mandarin listeners paid more attention to F0 direction (contour).

In addition to F0, the two varieties also differ in secondary perceptual cues for tones. Researchers have shown that the overall duration (Blicher *et al.* 1990), the temporal position of the turning point in the F0 contour (Liu and Samuel 2004), and the amplitude contour (Whalen and Yi Xu 1992) are all relevant perceptual cues for tones in Mandarin. Native listeners can identify the tones even in whispered speech with no F0 information (Liu and Samuel 2004). However, no such consistent secondary cues were found for Cantonese tone perception (Fok-Chan 1974, Vance 1977, Khouw and Ciocca 2007).

Tones in both varieties are subjected to coarticulation from neighboring context, and carryover coarticulation (left-to-right) is stronger than anticipatory coarticulation (right-to-left), e.g., in a disyllabic word AB, the influence of A on B is stronger than the other way round. The later portions of the tones carry the most canonical tone patterns and thus are more important for perception in both Mandarin and Cantonese (Yi Xu 1997, Khouw and Ciocca 2007).

2. Native and Non-native Perception of Tones

Tones are perceived differently by native and non-native speakers. Tone language speakers are better at discriminating tones in accuracy and speed than non-tone language speakers (Lee *et al.* 1996, Hallé *et al.* 2004, Wayland and Guion 2004, Francis *et al.* 2008, among many others). They are also more sensitive to pitch direction while non-tone language speakers generally pay more attention to pitch height (Gandour 1983, Francis *et al.* 2008). In addition, tone language speakers also perceive tones more categorically than non-tone language speakers. Categorical perception refers to the uneven perception of stimuli along an acoustic continuum: perception of stimuli across perceptual boundary is much better than within-category stimuli, although the acoustic change is the same among all stimuli. For example, listeners perceive an abrupt change of level to rising tone at a particular point along a pitch continuum (between-category), while they cannot perceive the same pitch differences on either side of that change (within-category). Wang (1967) was the first to demonstrate the difference in categorical perception of pitch contours by native Chinese and native English subjects. Such results were replicated by Yi Xu *et al*. (2006) and G. Peng *et al*. (2010) with both speech tones and non-speech tones. G. Peng *et al.* also found that the tone inventories in Mandarin and Cantonese influence the categorical perception of native listeners differently.

3. Perception of Tones in Different Contexts

Contextual variations can affect both the production and perception of tones. The interaction between intonation and tone has received much research interest since both involve F0 as the major acoustic correlate. Chao (1968:39) compared syllabic tone and sentence intonation with "small ripples riding on large waves (though occasionally the ripples may be larger than the waves)". Mandarin and Cantonese manipulate pitch differently to signal question intonation. Questions in Mandarin are signaled by a raised global F0 contour of the whole utterance as compared to a statement. The shapes of the lexical tones are unaffected and a boundary tone (i.e., a phonological tone located at the end of an intonational phrase) is unnecessary. Intonation patterns have minimal effects on the perception of Mandarin tones for native listeners (Connell *et al.* 1983, Yuan 2004). In contrast, a high boundary tone at the end of a question is characteristic of question intonation in Cantonese. All six lexical tones at this position show a rising F0 contour regardless of their canonical form, and they are easily misperceived as T2 [25] by native listeners. Tones produced within questions are more difficult to recognize than those in statements (see Fok-Chan 1974, Vance 1976, Ma *et al.* 2006). The difference in intonational patterns between Cantonese and Mandarin may be influenced by historical contact with different language groups.

Cantonese and Mandarin also differ in the interaction between musical melody and lexical tones. Lexical tones are mostly ignored in Mandarin popular songs as the four tones are distinguished by pitch contours rather than pitch height, while there is a close correspondence between tones and melody in modern Cantonese songs in which the relative pitch levels and pitch contours of lexical tones are preserved (Chan 1987). The Cantonese tone inventory with multiple level and rising tones in which they are distinguished by pitch height is a likely factor for the closer mapping between tones and melody. Wong and Diehl (2002) found that Cantonese listeners can make use of this relative mapping between musical and lexical tones to identify the underlying words embedded in musical tunes. (see *Tone and Music*)

Finally, there are some perceptual issues unique to Mandarin and Cantonese respectively. In Mandarin, when two T3 [214] abut, the first T3 will surface with a rising contour analogous to the canonical T2 [35]. This is known as the Tone 3 Sandhi in Mandarin. Studies show that while there are subtle acoustic differences between the sandhi-ed T3 and the canonical T2, listeners could not distinguish the two in perception (Wang and Li 1967, S. Peng 2000). (see *Tone Sandhi*)

Some Cantonese tones pairs are acoustically quite similar (T2 [25] vs T5 [23], T3 [33] vs T6 [22], and T4 [21] vs T6 [22]). These tone pairs are merging in recent years (Bauer *et al.* 2003). Native speakers who are merging tones are less sensitive to tonal distinctions in general than the non-merging speakers in that they have slower reaction time (Mok and Zuo 2012, Mok *et al.* 2013). Their perceptual patterns are in accordance with the idea that perception difficulty/confusion and listeners can be a source of sound change (Ohala 1981).

In summary, Mandarin and Cantonese differ in many aspects in tonal perception: (1) weighted attention to different acoustic features (F0 contour vs. F0 height) and the use of secondary acoustic cues; (2) modification of lexical tone contours by intonation patterns and the mapping between tones and melody; (3) tone sandhi vs. tone merge. These differences can be traced back to the different tone inventories of the two varieties.

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Bibliography

Bauer, Robert S. and Paul K. Benedict, *Modern Cantonese Phonology*, Berlin: Mouton de Gruyter, 1997.

Bauer, Robert S., Kwan-Hin Cheung and Pak-Man Cheung, “Variation and merger of the rising tones in Hong Kong Cantonese”, *Language Variation and Change* 15, 2003, 211–225.

Blicher, Deboray L., Randy L. Diehl and Leslie B. Cohen, “Effects of Syllable Duration on the Perception of the Mandarin Tone 2/Tone3 Distinction: Evidence of Auditory Enhancement”, *Journal of Phonetics* 18, 1990, 37–49.

Chan, Marjorie K.M., “Tone and Melody in Cantonese”, *Berkeley Linguistic Society*, *Proceedings of the Thirteenth Annual Meeting*, 1987, 26–37.

Chao, Yuen Ren, *A Grammar of Spoken Chinese*, Berkeley and Los Angeles: University of California Press, 1968.

Connell, Bruce A., John T. Hogan and Anton J. Rozsypal, “Experimental Evidence of Interaction between Tone and Intonation in Mandarin Chinese”, *Journal of Phonetics* 11, 1983, 337–351.

Fok-Chan, Yuen-Yuen, *A Perceptual Study of Tones in Cantonese*, Hong Kong: Hong Kong University Press, 1974.

Francis, Alexander L., Valter Ciocca, Lian Ma, and Kimberly Fenn, "Perceptual Learning of Cantonese Lexical Tones by Tone and Non-Tone Language Speakers", *Journal of Phonetics* 36, 2008, 268–294.

Gandour, Jackson T., "Tone Perception in far Eastern Languages", *Journal of Phonetics* 11, 1983, 149–175.

Gandour, Jackson T., "Tone Dissimilarity Judgments by Chinese Listeners", *Journal of Chinese Linguistics* 12, 1984, 235–260.

Hallé, Pierre A., Yueh-Chin Chang and Catherine T. Best, "Identification and Discrimination of Mandarin Chinese Tones by Mandarin Chinese vs. French Listeners", *Journal of Phonetics* 32, 2004, 395–421.

Howie, John Marshall, *Acoustical Studies of Mandarin Vowels and Tones*, Cambridge: Cambridge University Press, 1976.

Khouw, Edward and Valter Ciocca, "Perceptual Correlates of Cantonese Tones", *Journal of Phonetics* 35, 2007, 104–117.

Lee, Yuh-Shiow, Douglas A. Vakoch and Lee H. Wurm, "Tone Perception in Cantonese and Mandarin: A Cross-Linguistic Comparison", *Journal of Psycholinguistic Research* 25, 1996, 527–542.

Lin, Hwei-Bing and Bruno H. Repp, "Cues to the Perception of Taiwanese Tones", *Language and Speech* 32, 1989, 25–44.

Liu, Siyun and Arthur G. Samuel, "Perception of Mandarin Lexical Tones when F0 Information is Neutralized", *Language and Speech* 47, 2004, 109–138.

Ma, Joan K.-Y., Valter Ciocca and Tara L. Whitehill, "Effect of Intonation on Cantonese Lexical Tones", *Journal of the Acoustical Society of America* 120, 2006, 3978–3987.

Mok, Peggy and Donghui Zuo, "The Separation between Music and Speech: Evidence from the Perception of Cantonese Tones", *Journal of the Acoustical Society of America* 132, 2012, 2711–2720.

Mok, Peggy, Donghui Zuo and Peggy Wong, "Production and Perception of a Sound Change in Progress: Tone Merging in Hong Kong Cantonese", *Language Variation and Change* 25, 2013, 341–370.

Ohala, John J., "The Listener as a Source of Sound Change", in: C. Masek, R. Hendrick, and M. Miller ed., *Papers from the Parasession on Language and Behavior,* Chicago: Chicago Linguistic Society, The University of Chicago, 1981, 178–203.

Peng, Gang, Hong-Ying Zheng, Tao Gong, Ruo-Xiao Yang, Jiang-Ping Kong and William S.-Y. Wang, "The Influence of Language Experience on Categorical Perception of Pitch Contours", *Journal of Phonetics* 38, 2010, 616–624.

Peng, Shu-hui, “Production and Perception of Taiwanese Tones in Different Tonal and Prosodic Contexts”, *Journal of Phonetics* 25, 1997, 371–400.

Peng, Shu-hui, “Lexical versus 'Phonological' Representations of Mandarin Sandhi Tones”, in: M.B. Broe, and J. Pierrehumbert ed., *Acquisition and the Lexicon: Papers in Laboratory Phonology V*, Cambridge: Cambridge University Press, 2000, 152–167.

Vance, Timothy J., “An Experimental Investigation of Tone and Intonation in Cantonese”, *Phonetica* 33, 1976, 368–392.

Vance, Timothy J., “Tonal Distinctions in Cantonese”, *Phonetica* 34, 1977, 93–107.

Wang, William S.-Y., “Phonological Features of Tone”, *International Journal of American Linguistics* 33, 1967, 93–105.

Wang, William S.-Y. and Kung-pu Li, “Tone 3 in Pekinese”, *Journal of Speech and Hearing Research* 10, 1967, 629–636.

Wayland, Ratree and Susan G. Guion, “Training English and Chinese Listeners to Perceive Thai Tones: A Preliminary Report”, *Language Learning* 54, 2004, 681–712.

Whalen, Douglas H. and Yi Xu, “Information for Mandarin Tones in Amplitude Contour and in Brief Segments”, *Phonetica* 49, 1992, 25–47.

Wong, Patrick C.M. and Randy L. Diehl, “How Can the Lyrics of a Song in a Tone Language be Understood?”, *Psychology of Music* 30, 2002, 202–209.

Xu, Yi, “Contextual Tonal Variations in Mandarin”, *Journal of Phonetics* 25 1997, 61–83.

Xu, Yi, Jackson T. Gandour and Alexander L. Francis, “Effects of Language Experience and Stimulus Complexity on the Categorical Perception of Pitch Direction”, *Journal of the Acoustical Society of America* 120, 2006, 1063–1074.

Yuan, Jiahong, “Intonation in Mandarin Chinese: Acoustics, Perception and Computational Modeling”, dissertation, Cornell University, 2004.