PERCEPTION OF LEXICAL PITCH ACCENT BY KYUNGSANG AND CHOLLA KOREAN LISTENERS

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ABSTRACT

This paper investigates the identification and discrimination of lexical pitch accent by native and non-native dialectal listeners. Specifically, this research is focused on examining the relation between linguistic experience and phonetic levels of discrimination in speech perception. Participants identified and discriminated the continuum resynthesized from three pitch accent minimal pairs of North Kyungsang Korean. Results show that North Kyungsang listeners exhibited a sharper identification boundary and higher discrimination peak than South Cholla listeners. North Kyungsang listeners show the increase of between-category discrimination relative to within-category discrimination, whereas South Cholla listeners do not process them categorically, though showing some auditory sensitivity to all of the pitch accent contour variations. Moreover, in the case of pitch accent, within-category discrimination was better for listeners of dialects with pitch accents, than for listeners of dialects without pitch accents.

Keywords: perception, lexical pitch accent, North Kyungsang Korean, South Cholla Korean

1. INTRODUCTION

The perceptual ability of infants to distinguish prosodic patterns appears at a very early age, and this ability depends on the prosodic patterns of their native language. In a cross-linguistic study of tone perception, the categorical perception of lexical tone was well-defined for Taiwanese listeners, but French listeners did not perceive categorically [4], and similary, there is obvious evidence for categorical perception in Chinese listeners, but not in English listeners [17]. [3] reported that auditory sensitivity in tone perception is affected by a native language. Linguistic knowledge based on a listener's native language constrains the identification and discrimination of speech stimuli, beyond the auditory processing of the acoustic event itself [12].

The hypothesis that linguistic environment influences auditory and phonetic perception has been well developed in various experimental studies [2, 15], and accumulated experimental evidence holds that perceptual categorization is part of the biological property of humans [1, 16]. [2] found that one and four month old infants can discriminate speech sounds according to the manner in which adults discern a phonetic category boundary. [15] showed that the acquisition of a native sound occurs within the first year of infants' life.

Based on this hypothesis, the goal of current research concerns how the phonological effect of a local dialect creates the interaction between the linguistic environment and auditory/phonetic perception. In cross-dialect studies, there is a growing interest in categorizing speakers with respect to dialect. To examine the cognitive representation in dialectal variants, [14] conducted the map-drawing task which native speakers draw and label differently the American regions after they hear what people speak, and found that adults from four regions (i.e., Indiana, Michigan, New York, Hawaii) are sensitive to the dialectal variations. The participants accurately labeled the region which is close to their dialects in the map-drawing task.

This paper concerns the categorical perception of lexical pitch accent patterns in Korean. In the pitch accent system of Korean, the study of dialectal variants has been mainly focused on data classification for phonological analysis. In North Kyungsang dialect of Korean, the location of the pitch accent in a word is lexically determined, while in South Cholla varieties, there are no lexical contrasts marked by accent locations. The lexical and non-lexical pitch accent patterns of Korean have been researched in the fields of phonetics and phonology, and most studies have been focused on production data [6, 7, 8, 9, 10, 11]. In dialectal variants of Korean, there have been several cross-dialectal studies, but none concerning the categorical nature of lexical pitch accent in speech

perception. This research aims at examining specific auditory and phonetic categorical processes in comparison with discrimination performance in dialectal variations.

2. METHODS

2.1. Participants

Participants were 12 native speakers of North Kyungsang Korean from Daegu, which is the central city of the North Kyungsang region, and 10 native speakers of South Cholla Korean from Kwangju, which is the central city of the South Cholla region. The age of the North Kyungsang participants ranges between 19 and 22 years and that of the South Cholla participants between 32 and 39 years. None of participants reported any hearing problems, and all were compensated for their participation.

2.2. Stimuli

The stimuli were resynthesized from natural utterances of three pitch accent minimal pairs in North Kyungsang Korean (e.g., [moi]: HL vs. LH 'feed', 'conspiracy', [moɾe]: HL vs. HH 'sand', the day after tomorrow', [yaŋmo]: LH vs. HH 'wool', 'adoptive mother'). The resynthesized continuum was created by a pitch-synchronous overlap and add (PSOLA) algorithm, using Praat 4.4. The base tokens were resynthesized into three 9-step continua changing the original f0 pattern to that of the other member of the minimal pair (e.g., HL-LH → LH-HL, HH-HL → HL-HH, HH-LH → LH-HH).

2.3. Procedure

The experiment was conducted as a sequence of identification – discrimination tasks. Before doing the perception tasks, the participants first read the sentences containing the target words to help understanding of the stimuli to be used in the experiment. The identification task consisted of 432 trials containing 6 blocks of 72 trials, and the trials within a block were presented in random order. Each stimulus block was preceded by a practice phase of 16 trials. Participants were asked to press one of two buttons labeled with the members of the minimal pair displayed on a computer screen. For the discrimination task, an ABX two-step discrimination task was run. Participants were asked to judge whether the third item was the same as the first or the second one. This task consisted of 336 trials including 3 blocks of 112 trials presented in random order. Each stimulus block was preceded by a practice phase of 28 trials.

2.4. Data analysis

The probability of identification rate is predicted as a function of stimulus number as in the formula, $Y = 1/(1+EXP-(a+bx))$. The logistic linear function is parameterized in the form of $Y = a+bx$. The observed discrimination scores were automatically obtained by the perception test software ALVIN [5]. Based on these scores, between-category discrimination and within-category discrimination were measured as in [17]. The predicted discrimination scores based on identification was calculated by the formula as in [12, 13, 17].

3. RESULTS

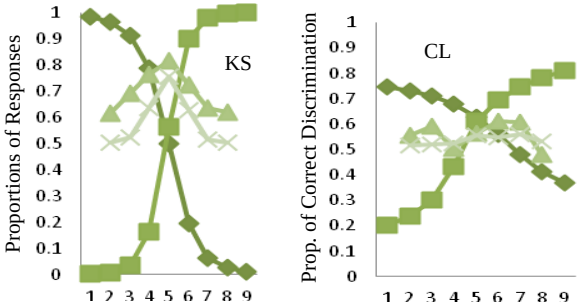
Figure 1 exhibits logistic identification functions for pitch accent patterns and observed and predicted discrimination curves. Regarding the identification functions, between the two dialectal groups, North Kyungsang and South Cholla, mean slope and intercept are significantly different for each minimal pair. A considerably sharper slope for category boundaries is seen for North Kyungsang listeners. Across the three minimal pairs, the slope is similar. Though both groups tend to split the continua into two categories with a boundary near the middle of the continua, the categorization function has a much sharper boundary in the North Kyungsang listeners. The intercept of North Kyungsang listeners is higher than that of South Cholla listeners. The intercept is not different across the different minimal pairs.

In Figure 1, observed discrimination curves obtained from the discrimination scores and predicted curves are overlaid. For North Kyungsang listeners, observed percent correct discrimination is consistently above 50%, containing a peak in the middle of each speech continuum. However, for South Cholla listeners, percent correct discrimination is around 50-60%, though the lexical pitch accent contrasts are not perceived categorically. In the relation of observed and predicted discrimination, the observed discrimination is higher than predicted for North Kyungsang listeners, but there is no distinctive difference for South Cholla listeners. The observed and predicted ABX discrimination accuracy is superimposed on fitted identification functions.

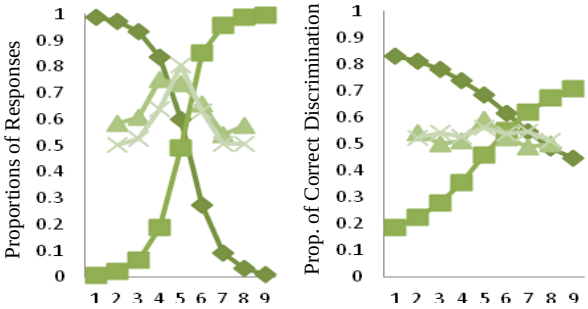
For North Kyungsang listeners, identification responses are well correspondent to the peak of observed and predicted discrimination accuracies. Specifically, the categorical boundary in identification functions corresponds to the peak of observed and predicted discrimination curves. However, for South Cholla listeners, identification responses do not predict discrimination probabilities. The observed and predicted discrimination curves do not show a peak around the middle of the identification function which is the categorical boundary. That is, the discrimination performance of South Cholla listeners is essentially flat, and does not vary in a consistent way along the continua. Therefore, the categorical boundary of the identification function for South Cholla listeners is not consistent with the peak of discrimination function as in the responses of North Kyungsang listeners.

Figure 1: Logistic identification functions for pitch accent patterns and observed and predicted discrimination curves. For identification response functions, the HL-LH/LH-HL, HH-HL/HL-HH, and HH-LH/LH-HH patterns were plotted. The two stimuli sets are laid out in each column, with the dark function indicating the first continuum, and the lighter function indicating the second continuum. The observed discrimination curves are darker than the predicted curves.

(a) HL-LH/LH-HL



(b) HH-HL/HL-HH



(c) HH-LH/LH-HH

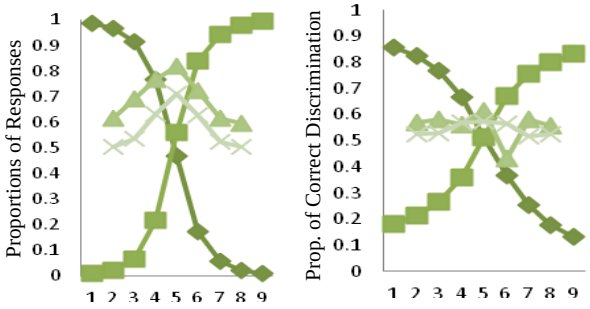
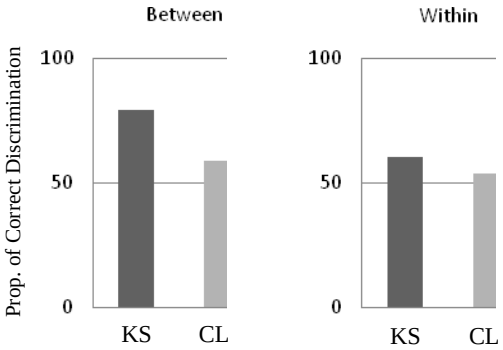


Figure 2 displays between-category discrimination and within-category discrimination scores. For North Kyungsang and South Cholla listeners, between-category discrimination and within-category discrimination are significantly different from chance. But North Kyungsang listeners are more sensitive in between-category discrimination and within-category discrimination than South Cholla listeners. This is not an effect like categorical perception, since categorical perception usually depresses sensitivity within categories. This finding may be due to two reasons. One is an increased attention to the dynamics of f0 in speakers of pitch accent dialects. The other is the fact the f0 differences are very auditorily salient, but such saliency is depressed by the fact that such pitch differences reside within a single category in the non-contrasting Cholla dialect.

Figure 2: Percent correct discrimination scores for between-category and within-category discrimination for North Kyungsang (KS) and South Cholla (CL) listeners.



4. CONCLUSION

Identification and discrimination of lexical pitch accent by North Kyungsang listeners are clearly formed around the phonologically contrastive property in their dialect of Korean. The ABX discrimination by North Kyungsang and South Cholla listeners in the current study confirms the

effect of phonological categorization between listeners from the two dialects. The major finding of this study is the fact that the large difference between the dialect groups appears as an increase in discriminability around category boundaries in the North Kyungsang listeners. In current research, the phonetic/acoustic model of speech perception replicates this pattern for pitch accent discrimination of dialectal variants in Korean, indicating that North Kyungsang listeners showed the increase of between-category discrimination in an identification boundary than South Cholla listeners.

5. REFERENCES

[1] Eimas, P.D. 1975. Speech perception in early infancy. In Salapatek, L.C. (ed.), *Infant Perception*, 193-231. New York: Academic Press.

[2] Eimas, P.D., Siqueland, E.R., Jusczyk, P., Vigorito, J. 1971. Speech perception in infants. *Science* 171, 303-306.

[3] Francis, A.L., Ciocca, V., Ng, B.K.C. 2003. On the (non)categorical perception of lexical tones. *Perception & Psychophysics* 65, 1029-1044.

[4] Hallé, P.A., Chang, Y.C., Best, C.T. 2004. Identification and discrimination of Mandarin Chinese tones by Mandarin Chinese vs. French listeners. *Journal of Phonetics* 32, 395-421.

[5] Hillenbrand, J.M., Gayvert, R.T. 2005. Open source software for experiment design and control. *Journal of Speech, Language, and Hearing Research* 48, 45-60.

[6] Jun, J.H., Kim, J.S., Lee, H.Y., Jun, S.A. 2006. The prosodic structure and pitch accent of Northern Kyungsang Korean. *Journal of East Asian Linguistics* 15, 289-317.

[7] Jun, S.A. 1993. *Phonetics and Phonology of Korean prosody*. Unpublished doctoral disseration, Ohio State University, Columbus, Ohio.

[8] Kenstowicz, M., Sohn, H.S. 1997. Focus and phrasing in Northern Kyungsang Korean. In Bertinetto, P.M. (ed.), *Certamen Phonologicum III*. Torino: Osenberg & Sellier, 137-156.

[9] Kim, C.G. 1976. *The Tonemic System of Gyeongsang Dialect*. Unpublished doctoral dissertation, Seoul National University, Seoul, Korea.

[10] Kim, G.R. 1988. *The Pitch Accent System of the Taegu Dialect of Korean with Emphasis on Tone Sandhi at the Phrasal Level.* Unpublished doctoral dissertation, University of Hawaii.

[11] Kim, N.J. 1997. *Tone, Segments, and their Interaction in North Kyungsang Korean: A Correspondence Theoretic Account.* Unpublished doctoral dissertation, Ohio State University, Columbus, Ohio.

[12] Liberman, A.M., Harris, K.S., Hoffman, H.S., Griffith, B.C. 1957. The discrimination of speech sounds within and across phoneme boundaries. *Journal of Experimental Psychology* 54, 358-368.

[13] Pollack, I., Pisoni, D.B. 1971. On the comparison between identification and discrimination tests in speech perception. *Psychonomic Science* 24, 299-300.

[14] Preston, D.R. 1986. Five visions of America. *Language in Society* 15, 221-240.

[15] Werker, J.F., Tees, R.C. 1984. Cross-language speech perception: Evidence for perceptual reorganization during the first year of life. *Infant Behavior and Development* 7, 49-63.

[16] Whalen, D.H., Liberman, A.M. 1987. Speech perception takes precedence over nonspeech perception. *Science* 237, 169-171.

[17] Xu, Y., Gandour, J.T., Francis, A.L. 2006. Effects of language experience and stimulus complexity on the categorical perception of pitch direction. *Journal of the Acoustical Society of America* 120, 1063-1074.