

THE EFFECT OF ACOUSTIC INFORMATION OF LEXICAL TONES ON NON-NATIVE LISTENERS' TONAL IDENTIFICATIONS

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1. INTRODUCTION

This paper reports a perception study in lexical tones by non-native speakers of Mandarin. The role of acoustic information of lexical tones in a perception training is examined.

Although studies (Leather, 1990; Wang et al., 1999) have shown that auditory-training improves non-native listeners' tonal identification, persistently perceptual confusions of several tone pairs are still observed after a considerable amount of training. For example, a high falling tone is misidentified as a high level tone. This implies that learners have not yet learned the lexical tones.

Learners' tonal confusions might be reduced further if the acoustic information of tones, such as intrinsic duration-pattern and pitch contour, could be implemented and emphasized during training. In general, learners in those studies involving auditory-training do not receive explicit explanations for a given contrastive tone pair when the response is incorrect. However, studies in tonal perception (Gandour, 1984; Massaro et al., 1985), have clearly demonstrated that acoustic cues (e.g., pitch height and contour) are essential for the identification of tones. Accordingly, employing acoustic cues of lexical tones during training may have a fruitful result. To verify the above assumption, the present study examines the effect of using acoustic information of lexical tones as feedback on non-native listeners' performance during a computer-based perception training of Mandarin tones.

Mandarin has four lexical tones, each of which has a unique pitch pattern: Tone 1 – high level, tone 2 – mid-rising, tone 3 – low rising, and tone 4 – high falling. In the present study, two pairs of tones (tone 1 vs. tone 4 and tone 2 vs. tone 3) were investigated, since learners of Mandarin have great difficulties producing and perceiving these tone pairs (Shen, 1989; Sun, 1998).

2. METHOD

2.1 Participants

The listeners were 24 non-native speakers with no prior knowledge of Mandarin, ranging in age from 18 to 37 years ($M = 24.5$ years). They were randomly assigned to one of two groups: control vs. experimental.

2.2 Material

The present study used a total of 13 CV syllables, each of which has a lexical meaning when associating with one of the four tones. All stimuli were produced by two native Mandarin speakers (1 male & 1 female) who were born and raised in Beijing. Their speech samples were correctly identified (100%) by another female native Mandarin speaker born and raised in Beijing. These digitized stimuli were used for a hypermedia authoring computer program, Mandarin Tonal Tutor (MTT), to carry out the experiment. The MTT program has two versions: Simple feedback (SF) and Detailed feedback (DF). The listeners in the control group used the SF version, and those in the experimental group were trained with the DF version. The MTT program consisted of four phases: an introduction, a pre-test, seven training exercises, and a post-test.

2.3 Training

The training session was about 30-45 minutes. In the SF version, the listeners were merely shown that the answer was right or wrong (i.e., no acoustic information was provided). In contrast, the listeners using the DF version received acoustic information by means of both visual and auditory feedback whenever they made an error. The feedback came in three forms: (a) text describing the essential acoustical characteristic differences, (b) pitch graphs, and (c) audio files for the contrastive tonal pairs.

3. RESULTS & DISCUSSION

Listeners' scores for the post-test were higher than those of the pre-test. However, the performance for the listeners in the two groups was different. On average, listeners who used the DF version showed an increase of 21.61% in the post-test, whereas those who received the SF version only had an increase of 4.95% in the post-test.

Listeners' perception scores for the pre- and post-tests were submitted to a mixed ANOVA, with Group (control vs. experimental group) as a between-subjects factor, and Test (pre-test vs. post-test) as a within-subjects factor. The statistical analysis revealed a significant effect of Test on the scores, $F(1, 22) = 48.77$, $p < .01$, indicating that the listeners had a higher score in the post-test than the pre-test. However, the effect of Group did not approach significance, ($p > .05$). Furthermore, there was a significant Group x Test interaction, $F(1, 22) = 17.78$, $p < .01$, indicating that the listeners who were trained with the DF version significantly outper-

formed those who used the SF version in the post-test (see Fig. 1).

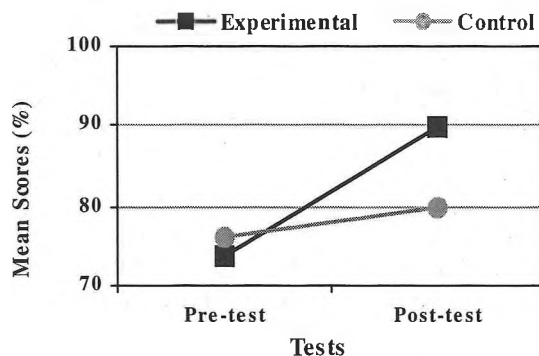


Fig. 1. Mean scores (%) of the listener groups for the pre- and post-test.

Identification errors made by the listeners in the two groups in the pre- and post tests were also examined. Their errors are shown in Figure 2 (for the control group) and in Figure 3 (for the experimental group).

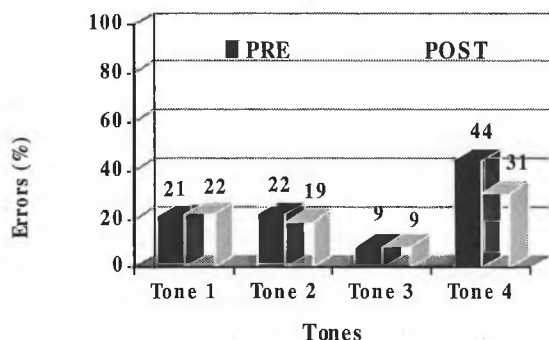


Fig. 2. Errors (%) for the control group in the pre- and post-tests

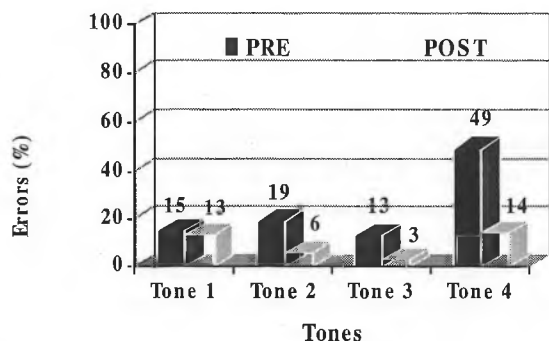


Fig. 3. Errors (%) for the experimental group in the pre- and post-tests

As shown in the figures, the listeners in the experimental group show dramatic and consistent improvement in the post-test, from 2% to 35% (Fig. 2). In contrast, the same pat-

tern of improvement is not observed in the performance for the listeners in the control group; their errors reduce from 0% to 13% only (Fig. 3).

4. CONCLUSION

The present study examines the role of acoustic information in the perception training of Mandarin tones. The results indicate that using acoustic information as feedback during a short-span training significantly improves listeners' performance in tonal identifications, and that the pattern of improvement is consistently observed for each lexical tone. This suggests that feedback with the acoustic information during training assists non-native learners to learn the lexical tones, since the contrastive characteristics of the tone pairs are shown to them. A further examination in listeners' speech productions is desirable to find out if these learners are able to produce the tones according to the acoustic information that they have received during training.

REFERENCES

- Gandour, J. (1984). Tone dissimilarity judgements by Chinese listeners. *Journal of Chinese Linguistics*, 12(2), 235-261.
- Leather, J. (1990). Perceptual and productive learning of Chinese lexical tone by Dutch and English speakers, In J. Leather & A. James (Eds.), *New Sounds 90* (pp. 72-89). Amsterdam: University of Amsterdam.
- Massaro, D. W., Cohen, M. M. & Tseng, C. Y. (1985). The evaluation and integration of pitch height and pitch contour in lexical tone perception in Mandarin Chinese. *Journal of Chinese Linguistics*, 13(2), 267-289.
- Shen, X. (1989). Toward a register approach in teaching Mandarin tones. *Journal of the Chinese Language Teachers Association*, 24(3), 27-47.
- Sun, S. (1998). *The development of a lexical tone phonology in American adult learners of standard Mandarin Chinese*. Honolulu, HI: University of Hawai'i Press.
- Wang, Y., Spence, M., Jongman, A., & Sereno, J. (1999). Training American listeners to perceive Mandarin tones. *The Journal of Acoustical Society of America*, 106(6), 3649-3658.

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