

Perceptual Assimilation of Hindi Dental and Retroflex Stop-Consonants by Native English and Japanese Speakers

John S. Pruitt*, Reiko Akahane-Yamada*, & Winifred Strange†

*ATR-HIP Labs, 2-2 Hikaridai, Seika-cho, Soraku-gun, Kyoto, 619-02, Japan

†Department of Comm. Sciences & Disorders, University of South Florida, Tampa, Florida, 33620-8150

Abstract: The present study attempted to ascertain the patterns of assimilation of Hindi dental versus retroflex stop consonants by native speakers of English and Japanese. Participants were asked to categorize multiple instances of this Hindi contrast, produced in different voicing/manner classes with different vowels. Marked differences were found between the two language groups which were dependent upon the voicing/manner class of the contrast.

INTRODUCTION

Previous research has shown that English speakers have great difficulty distinguishing the dental and retroflex stop-consonants of the Hindi language (1,2). However, native Japanese speakers have less difficulty perceiving this contrast even though it is similarly not employed in the Japanese language (see Figure 1; data taken from [3]). Best and her colleagues (4) have attributed differences in the perception of non-native speech sounds to differences in the assimilation of such sounds to native-language speech categories. According to Best's Perceptual Assimilation Model (PAM), four patterns of assimilation have been described which are purportedly predictive of perceptual difficulty. To determine whether this model could be applied to the present case, we investigated the assimilation patterns of the Hindi phonemes for these two language groups. English and Japanese speakers categorized multiple instances of these Hindi consonants in different voicing/manner classes and with different vowels. Based on the findings of previous studies (1,2,5), especially those shown in Figure 1 (3), we expected that Japanese subjects would show evidence for a two-category assimilation pattern while English subjects would show evidence for a single-category assimilation pattern as illustrated in Figure 2.

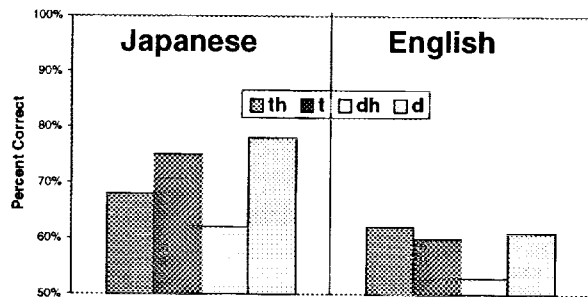


FIGURE 1. Japanese and English Speakers' Perceptual Performance on Hindi Dental and Retroflex Consonants.

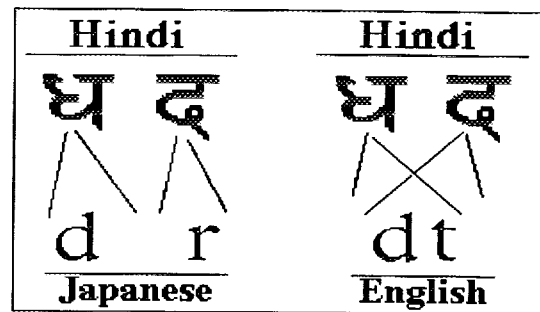


FIGURE 2. A Conceptual Diagram of Perceptual Assimilation Differences on Hindi Dental vs Retroflex.

METHODS

Subjects. Twelve native English (average age, 28.4) and 12 native Japanese (average age, 20.7) speakers participated as subjects. All subjects were free of any hearing deficiencies as screened by self-report. English subjects were tested in the USA and Japanese subjects were tested in Japan.

Stimuli. Two adult male speakers of Hindi produced multiple instances of the Hindi dental and retroflex consonants. Twenty-four different consonant-vowel syllables - dental and retroflex in each of four manner/voicing contexts (voiceless-unaspirated /t/, voiceless-aspirated /tʰ/, voiced-unaspirated /d/, and voiced-aspirated /dʰ/) were produced with each of three vowels (/a/, /e/, and /o/). For each speaker, there were 4 exemplars of each consonant; thus, a total of 96 tokens per speaker.

Procedure. The Hindi productions were presented in random order. Subjects simply listened to the exemplar and then clicked on a labeled button to identify the category they heard. The response categories were determined by having native Japanese and English speakers transcribe the Hindi productions into their respective native language. Thus, the response categories varied slightly by language group. The Japanese response categories were "P", "T", "K", "B", "D", "G", "R", and a vowel-only category. The English response categories were "Th", "P", "T", "D", "L", "R", and a vowel-only category.

RESULTS

As shown in Figures 3 to 6, the two language groups showed variations in assimilation performance based on the voicing/manner class of the contrast. For the purpose of brevity, the data are collapsed across vowel contexts. While not clearly evident in Figure 3 (voiceless-aspirated context), both language groups primarily showed a single-category assimilation pattern for /a/ and /e/ vowel context (dental and retroflex /t/ go to "t"). However, a two-category assimilation pattern was found in the /o/ context (dental /t/ goes to "t" and retroflex /t/ goes to "p"). Figure 4 (voiced-unaspirated) shows strong evidence for a two-category pattern for Japanese speakers and a single-category pattern for English speakers. Figure 5, and especially Figure 6 (voiceless-unaspirated and voiced-aspirated, respectively), shows somewhat similar evidence for Japanese speakers as in Figure 4, but for English speakers, the pattern has switched to a single-category pattern which spans 3 phonemes. That is, BOTH dental and retroflex consonants are heard sometimes as /d/, sometimes as /t/, and sometimes as /θ/ (theta).

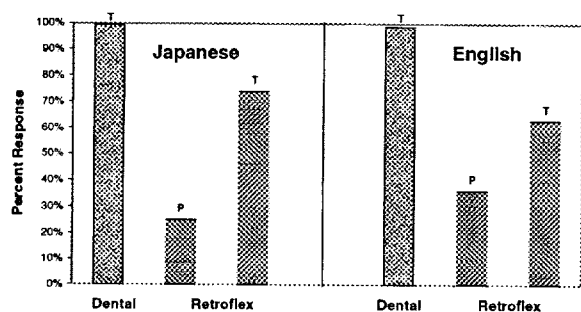


FIGURE 3. Percent Category Responses on /tʰ/.

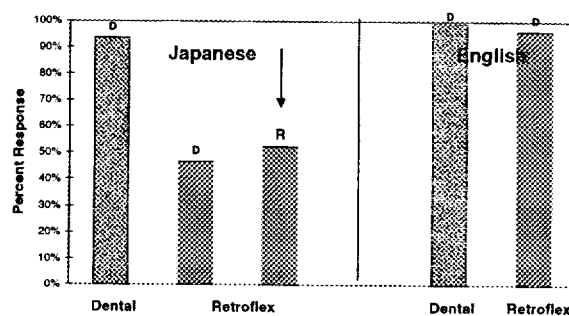


FIGURE 4. Percent Category Responses on /d/.

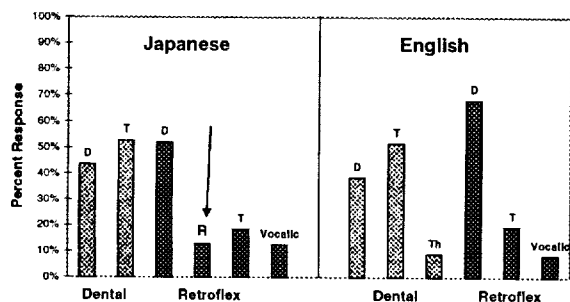


FIGURE 5. Percent Category Responses on /t/.

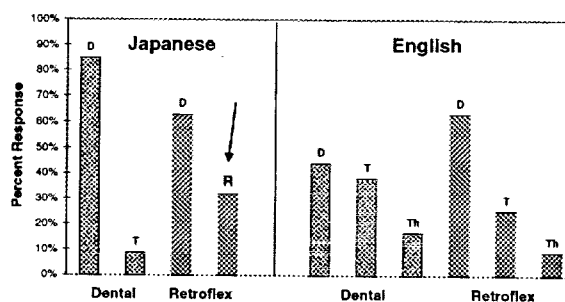


FIGURE 6. Percent Category Responses on /dʰ/.

CONCLUSION

Differences in assimilation between Japanese and English speakers provide some insight into why or how Japanese speakers have less difficulty with non-native Hindi contrast; they hear dental consonants as /d/ or /t/ and retroflex consonants as some variant of their flapped /t/. While PAM facilitates this understanding, it does not provide a clear fit to all aspects of our results. Most notably, the differences in perceptual difficulty inherent in the four voicing/manner classes (as can be seen in Figure 1) are less-well understood (2).

ACKNOWLEDGMENTS

The authors would like to thank Alicia Francis, Rieko Kubo, and Kanae Nishi for their help in collecting the data for this research. This work was supported in part by a grant to Dr. Winifred Strange from NIDCD.

REFERENCES

1. Tees, R.C. & Werker, J.F., *Canadian Journal of Psychology*, 38, 579-590 (1984).
2. Polka, L., *Journal of the Acoustical Society of America*, 89, 2961-2977 (1991).
3. Pruitt, J.S., *Journal of the Acoustical Society of America*, 94, 3417 (1995).
4. Best, C.T., McRoberts, G.W., & Sithole, N., *Journal of Experimental Psychology: Human Perception & Performance*, 14, 345-360 (1988).
5. Price, P.J., A cross-linguistic study of flaps in Japanese and in America English, *Unpublished Doctoral Dissertation*, University of Pennsylvania, (1981).