The comparisons of English tense-lax vowel contrasts perceived by English monolingual children and Mandarin-English bilingual children

Lan Yu, Indiana University, department of linguistics, ly29@indiana.edu

Spectral differences or vowel quality differences and durational differences are argued to serve as the acoustic cues for the perception of English tense-lax vowel contrasts (Hillenbrand et al., 1995; Reetz and Jongman, 2009; Smiljanic and Bradlow, 2008). English native speakers and second language (L2) speakers (Korean, Russian, Spanish and Mandarin) of English are reported to treat those two cues differently. Native speakers give more perceptual weight to spectral cues but L2 speakers weight durational cues more heavily (Tsukada at al., 2005; Kondaurova & Francis, 2008; Wang & Munro, 1999; Hsieh & Pan, 2010).

Here we explore the cue weighting strategies adopted by seven 5-9-year-old children, which is much less investigated previously. Our goal is to compare the strategies used by English monolingual children (EC) and Mandarin-English bilingual children (MEC). Two adult control groups, three English-speaking adults (EA) and four Mandarin-English bilingual adults (MEA) were also included to observe the developmental changes. Perception stimuli were obtained from natural productions of “sheep” and “ship”. We resynthesized the natural tokens to create a sheep/ship continuum in six perceptually equal spectral and durational steps using Pratt. To make the experiment more children-friendly, we introduced this word pair by presenting the subjects with the corresponding pictures as shown in pics 1 and 2. In the identification experiment, there were 72 target trials (6 durational steps * 6 spectral steps * 2 repetitions) and 144 dummy trials. Regarding each target trial, subjects saw four pictures (two of them were pics 1 and 2) presented on the computer screen and heard the resynthesized token at the same time. They were asked to click the corresponding picture for the word they heard. The designing of the dummy trials was similar to the target trials except that they heard a dummy word and pics 1 and 2 were not included. The purpose of the dummy trials was to make the study more interesting to the children.

Identification (ID) functions for duration and spectrum are shown in Figs (1a) and (1b). The results show that all groups except MEA relied predominantly on spectral differences. Considering MEA, they are also sensitive to the durational differences. Additionally, identification (ID) matrixes for those four groups are illustrated in Figs (2a), (2b), (2c) and (2d). ID matrixes illustrate a more complex pattern that with respect to EC, MEC and EA, durational differences have effects only on the middle spectral steps 2 and 3, where the subjects were not certain about how to classify using the spectral cues. However, both spectral and durational cues are important to MEA. In conclusion, the findings from this study support the previous studies on the perception of this contrast on adult groups. We also note that both children groups perform very similarly, and both weight predominantly on spectral cues. In addition to this, this study suggests that it may not be necessary that development changes the strategies of cue weighting regarding first language (L1) acquisition as proposed by previous developmental research on cue weighting of speech perception (Ohde & German, 2011). This study fills in the gap on the developmental cue weighting of English tense and lax vowel contrasts, yet the reasons why the L2 adults group not children group are sensitive to durational differences needs more attention and investigations in the future.
Selected references


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1 Proportion sheep responses were calculated as average groups responses.

2 Spectral steps 1 to 6 are from sheep to ship and durational steps 1 to 6 are from long to short. Darker area indicates more sheep identifications. The darkest areas indicate 100% sheep identifications and the lightest areas indicate 100% ship identifications.