Children's variable production patterns of American English diphthongs

The current study examines children's production patterns of the English diphthongs /aɪ, aʊ, eɪ, oʊ/ in comparison to adult speakers with respect to formant frequencies. Previous studies on English vowel development (e.g. Hillenbrand et al. 1995, Lee et al. 1999) have shown that children produce different patterns of formant frequencies than adult speakers, and that they also have larger F1-F2 vowel spaces than the adults. In addition to differences in magnitude, children were also found to have greater spectral variability than adults. This variability in formant frequencies has been shown to decrease with age (e.g. Eguchi and Hirsh 1969). The main focus in those studies, however, was monophthongs. It is unclear whether diphthongs follow similar patterns of acquisition.

There is a general consensus in the literature that diphthongs are dynamic entities, even more so than monophthongs (Harrington and Cassidy, 1994). Within the category of diphthongs investigated in the current study, /aɪ, aʊ/ involve greater spectral change than /eɪ, oʊ/. Does this difference in spectral change affect the acquisition patterns of diphthongs? To address this question, a picture-naming experiment was carried out to test the hypothesis that diphthongs involving greater spectral change are harder to acquire than those with less spectral change. If this hypothesis is true, we would expect more variability in the production of /aɪ, aʊ/ than /eɪ, oʊ/.

Participants were 15 American English native speakers who were recorded in the New York City area: 6 adults (3 males, 3 females), 4 school-age children (6-7 year-olds: all males), and 5 preschoolers (4-5 year-olds: 3 males, 2 females). Five repetitions of four diphthongs (/aɪ, aʊ, eɪ, oʊ/) in monosyllables such as *bye, bow, day*, and *dough* were elicited in carrier sentences. A total of 60 tokens were obtained from each participant. Spectral analysis was performed by extracting 50 equidistant measurements along F1 and F2 trajectories for each token. The 50-point contours were then submitted to statistical comparisons using SSANOVA (Davidson, 2006). Spectral variability analysis, on the other hand, was performed by calculating coefficients of variability at three time points, corresponding to the 20th, 50th, and 80th percentiles.

The analysis yielded results that are consistent with previous findings that children generally have larger F1-F2 vowel spaces than adult speakers. For instance, the high offsets of /eɪ, oʊ/ are higher for children than adults, and the back onsets of /aʊ, oʊ/ are backer for children than adults. The latter result, however, may be attributed to a phenomenon of coarticulation, by which the /a/ subcomponent of the diphthong was produced lower than that of the adults due to preparatory gestures for the back offset /ʊ/. The influence of coarticulation on children but not adults may be accounted for by the fact that children may not have a clear representation yet of the diphthong's onset vowel target and its difference from the corresponding monophthong.

With respect to variability, the results indicated that both child groups were significantly more variable than the adult speakers. Pairwise comparisons further revealed that in general the older children showed significantly more variability than the younger children for the production of /aʊ/ (F1: $p<.01$, F2: $p<.05$), but not for the other diphthongs. The analysis by time point indicated that while the younger child group showed more variability than the older groups in the production of /aɪ/'s offsets (F2: $p<.01$), they were significantly less variable than the older children in the production of /aʊ/'s onset (F2: (F2: $p<.05$) (see figure 1). Flege et al. (1986) reported that /aʊ/ may be produced with greatly reduced tongue movement but with increased lip-rounding as a compensatory gesture. This variation in /aʊ/ production may be at the origin of the older children's great variability, especially given that they may be exposed to even more variable production at school from other school-age children than the younger children who are still in preschool stage.

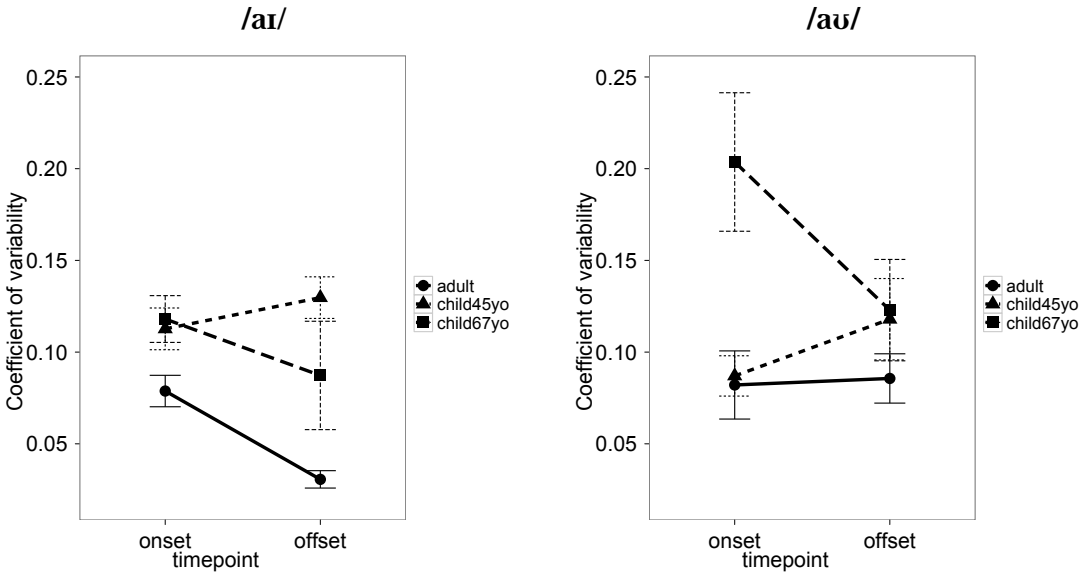

Figure 1: F2 variability comparison for for /aɪ, aʊ/ at onset (20th percentile) and offset (80th percentile) between adults, 4-5 year-olds, and 6-7 year-olds.

References

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