Developmental trajectory of L2 and L3 vowel perception: Acoustic and perceptual similarity of English and Norwegian vowels to Polish vowel categories

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The study aimed to examine the relationship between L3 Norwegian and L2 English vowel assimilation patterns to L1 Polish vowel categories and the acoustic distance between the vowels operationalized as the Euclidean distance. Previous research focused mostly on the second language (L2) perceptual assimilation patterns (Cebrian 2022, Tyler et al. 2014), and the relationship between vowel perception and acoustic parameters (Escudero et al. 2012). The novelty of the present contribution is to expand the scope to the third language (L3) and to account for the time perspective.

Our hypotheses for the L1-L2-L3 perceptual and acoustic similarity were as follows:

H1: The smaller the Euclidean distance (ED) between the two vowels, the higher the likelihood of assimilating a given L2/L3 vowel to a native Polish category.

H2: The reliance on ED will decrease with time.

H3: The Euclidean distance will predict assimilation better in L3 than in L2.

H4: Lip rounding and vowel length may modulate the assimilation patterns.

The participants involved 24 native Polish speakers (mean age 19.86) with L2 English (intermediate) and L3 Norwegian (beginner) learnt in a formal instructed setting. They were tested three times over the first year of L3 Norwegian instruction. The L2 and L3 perception was tested using PsychoPy (Peirce et al. 2019) separately on different days. In the perceptual assimilation task the participants were asked to assimilate 10 English and 16 Norwegian monophthongs embedded in nonce words /dVd/ to six Polish vowel categories (with orthographic labels) and to rate their goodness of fit on a 7-point scale. We examined the relationship between assimilation rates of English/Norwegian vowels to each Polish category, and the Euclidean distance between the reference vowels for Polish (Weckwerth and Balas 2019) and the English/Norwegian vowels presented in the perception experiment.

Statistical analysis was run in R (R Core Team 2022). The analysis using a negative binomial model for count data demonstrated that the larger the Euclidean distance, the fewer assimilations were predicted. Moreover, a stronger effect of the Euclidean distance was found in L3 Norwegian than in L2 English. The predicted effect of the Euclidean distance on assimilation count in both languages was the strongest at the first testing time and it diminished at T2 and T3 in both of the languages tested. There was some indication that marked lip rounding may influence assimilation patterns, however, vowel length did not play a role. A mixed effects linear model of Likert rating as a function of Euclidean distance, language and their interaction (with a by-participant random intercept) showed that the larger the Euclidean distance, the lower the goodness ratings and that English vowels were rated higher than Norwegian vowels.

All in all, the developmental trajectory of L2 and L3 vowel perception indicated that perceptual targets were largely modulated by the Euclidean distance, but they were also influenced by other phonetic features. Importantly, the perceptuo-acoustic similarity patterns appeared to be restructured during the first year of L3 learning pointing to the role of learning experience in developing L2/L3 vowel perception.

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