

## Vowel perception in L2 and L3: Acoustic and perceptual similarity of English and Norwegian vowels to Polish vowel categories

This study attempts to compare L2 English and L3 Norwegian vowel assimilation to L1 Polish vowel categories. The perceptual similarity is juxtaposed with acoustic similarity, and lip rounding and duration are examined as factors which may potentially skew the perception results.

Previous research has been dominated by the focus on the L2: perceptual assimilation patterns (Best and Tyler 2007, Tyler et al. 2014), and the relationship between vowel perception and acoustic parameters (Escudero, Simon, Mitterer 2012). In the present contribution we broadened the scope to cover L3 in addition to L2. We contrasted perceptual similarity and acoustic similarity operationalized as the Euclidean distance. The hypothesis claims that the smaller the Euclidean distance between two vowels, the bigger the likelihood of assimilating a given English/Norwegian vowel to a Polish category. We also incorporated lip rounding and duration differences as the factors which are likely to influence the assimilation patterns.

21 subjects with L1 Polish, L2 English and L3 Norwegian, 14 females, 7 males, (mean age 19.86), who learned English as L2 (for 12.23 years on average) and Norwegian as L3 for two months (initial stages) in an instructed setting, participated in the study. They were asked to assimilate 10 English and 16 Norwegian monophthongs embedded in nonce words /dVd/ to six Polish vowel categories (orthographic labels, as Polish vowel orthography is transparent) and rated their goodness of fit on a 7-point Likert 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.

We fitted a linear model to predict Assimilation Rating as a function of the Euclidean Distance and the effect of Euclidean Distance is statistically significant ( $\beta = -0.03$ ,  $t(142) = -5.98$ ,  $p < 0.001$ ). We observed more variation in assimilation rates and goodness ratings in the case of high front (English KIT, Norwegian FIN) and central/back rounded vowels (English FOOT, Norwegian BOK) and in the English rhotacized mid central NURSE vowel and uncategorized assimilation types in the case of mid central rounded vowels (Norwegian LØP and LYS) with similar Euclidean distances to many Polish categories, but no single counterpart. These more varied assimilation patterns show that perceptual assimilation is not just a function of Euclidean distance but is sensitive to features such as lip rounding and rhotacization. The effect of Euclidean Distance on Likert scale ratings is also significant ( $\beta = -0.002$ ,  $t(142) = -6.62$ ,  $p < 0.001$ ). When we added the individual vowels to the model the keyword GOOSE, interaction between ED and FOOT and between ED and GOOSE also proved significant. English free vowels and Norwegian long vowels tended to be assimilated with higher goodness ratings to Polish categories and English vowels seemed to yield higher goodness ratings. It remains to be examined whether this is due to unfamiliarity with Norwegian vowels or more marked vowel feature combinations in high and central front rounded vowels.

## References:

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