

Speakers, listeners, languages: Coarticulatory variability and contrast in spoken language dynamics

Marianne Pouplier¹

¹*Ludwig-Maximilians University Munich (Germany)*
pouplier@phonetik.uni-muenchen.de

In this talk, I will report on our recent work which seeks to understand to which extent coarticulatory variability in speech production and perception may be shaped by phonological contrast and, at the same time, vary between individuals of the same language community. Language-specific sound systems have been argued to be influential factors governing the degree of coarticulation, and the maintenance of phonological contrast is expected to restrict the temporal extent of articulatory anticipation [1-4]. Yet evidence for the intuitively appealing role of contrast has remained ambiguous [5, 6]; variation between languages does not necessarily pattern as predicted by phonological structure. For nasality, the presence of contrast may indeed constrain coarticulation (e.g., French), or the absence of contrast may enable extensive coarticulation (e.g., English), yet for other languages, nasal coarticulation has been found to be either unexpectedly limited in the absence of a contrast (e.g., Spanish [4]), or unexpectedly extensive despite the presence of a contrast (e.g., Lakota [7]). For labial coarticulation, the picture is similarly complex [8, 9], albeit there being far fewer studies.

Another, related point of discussion in coarticulation research is the role of individual variation. While the individual variation that is observable among speakers of the same language (e.g., [10]) has often been set aside as experimental 'noise', recent work particularly on nasality has put this individual variation at the heart of explanations for sound change. Individuals within a language community may differ systematically in how they produce and perceive coarticulation, rather than contrast acting as a constraining force on coarticulation in a monolithic fashion [11]. The implications of this shift in perspective on variability within a language for our understanding of between-language variation in coarticulation are yet to be explored.

Due to small sample sizes in many studies, our knowledge about the nature of language specific effects on coarticulation does not always stand on firm ground. Indeed, Noiray et al. [8] contested the notion that coarticulation is language specific at all: their study on anticipatory lip rounding in English and Canadian French, yielded no evidence of systematic patterns by language, despite French, but not English contrasting rounding on vowels. They therefore concluded that the implementation of anticipatory lip rounding is purely speaker-dependent, contra older work on labial coarticulation by Lubker & Gay [9].

To broaden our understanding of how the scope of anticipatory coarticulation may interact with a language's phonology, how it is planned, and perceived, we have undertaken a large-scale comparative study on contextual vowel nasalization as well as lip rounding in three languages. We recorded nasalance and 'blue lip' video data [12] for French, German, and American English for 25-30 speakers per language [13, 14]. For English, neither nasality nor rounding is contrastive for vowels, for French, both are contrastive whereas German contrasts lip rounding only. This allows us to study, for the same speakers, the coarticulatory behavior for two independent articulators, in the presence or absence of a phonological contrast (across languages). Production data will be complemented by perception experiments probing the production-perception link.

For nasality, our results so far confirm the expectation of language specific effects: French is most limited in its coarticulatory scope, whereas English has the greatest temporal extent of anticipatory nasalization. German falls between the two other languages, differing from neither one [15]. For all languages we find a range of individual variation: some speakers show an extensive temporal range of anticipatory coarticulation while others coarticulate comparatively little. First analyses suggest that speakers who coarticulate most extensively for nasality do not

necessarily do so for lip rounding, meaning there is no general speaker-specific coarticulatory setting.

For lip rounding, coarticulation is, perhaps surprisingly, similarly extensive in both English and German with a high degree of individual variation. Our results align with Noiray et al.'s previous observation for French vs. English that individual variation dominates any group-level effects. Our data analysis for lip rounding in French is still in progress.

Overall, our results thus resonate with other studies which cast doubt on phonological contrast being a good predictor of the temporal extent of coarticulation (among others, [7, 16]). Within each language, coarticulation is both speaker and articulator specific. Language-specific effects, to the extent present, do not necessarily align with phonological contrast.

Work supported by DFG grant PO 1269/5-1

References

- [1] Öhman, S.E., Coarticulation in VCV utterances: Spectrographic measurements. *Journal of the Acoustical Society of America*, 1966. **39**(1): p. 151-168.
- [2] Manuel, S., The role of contrast in limiting vowel-to-vowel coarticulation in different languages. *Journal of the Acoustical Society of America*, 1990. **88**(3): p. 1286-1298.
- [3] Delvaux, V., D. Demolin, B. Harmegnies and A. Soquet, The aerodynamics of nasalization in French. *Journal of Phonetics*, 2008. **36**(4): p. 578-606.
- [4] Solé, M.-J., Spatio-temporal patterns of velopharyngeal action in phonetic and phonological nasalization. *Language and Speech*, 1995. **38**: p. 1-23.
- [5] Mok, P., Language-specific realizations of syllable structure and vowel-to-vowel coarticulation. *Journal of the Acoustical Society of America*, 2010. **128**(3): p. 1346-1356.
- [6] Mok, P., Does vowel inventory density affect vowel-to-vowel coarticulation? *Language and Speech*, 2012. **56**(2): p. 191-209.
- [7] Scarborough, R., G. Zellou, A. Mirzayan and D.S. Rood, Phonetic and phonological patterns of nasality in Lakota vowels. *Journal of the International Phonetic Association*, 2015. **45**(3): p. 289-309.
- [8] Noiray, A., M.-A. Cathiard, L. Ménard and C. Abry, Test of the movement expansion model: Anticipatory vowel lip protrusion and constriction in French and English speakers. *The Journal of the Acoustical Society of America*, 2011. **129**(1): p. 340-349.
- [9] Lubker, J. and T. Gay, Anticipatory labial coarticulation: Experimental, biological, and linguistic variables. *The Journal of the Acoustical Society of America*, 1982. **71**(2): p. 437-448.
- [10] Grosvald, M., Interspeaker variation in the extent and perception of long-distance vowel-to-vowel coarticulation. *Journal of Phonetics*, 2009. **37**(2): p. 173-188.
- [11] Beddor, P.S., A.W. Coetzee, W. Styler, K.G. McGowan and J.E. Boland, The time course of individuals' perception of coarticulatory information is linked to their production: Implications for sound change. *Language*, 2018. **94**(4): p. 931-968.
- [12] Lallouache, M.T., *Un poste "Visage-parole" couleur. Acquisition et traitement automatique des contours des lèvres [A "face-speech" interface. Automatic acquisition and processing of labial contours]*. 1991, PhD thesis, Institut National Polytechnique de Grenoble.
- [13] Lo, J.H., C. Carignan, M. Pouplier, F. Rodriguez, R. Alderton, B.G. Evans, and E. Reinisch, Language specificity vs speaker variability of anticipatory labial coarticulation in German and English. *Proceedings of the 20th International Congress of Phonetic Sciences, Prague, 2023*.
- [14] Rodriguez, F., M. Pouplier, R. Alderton, J.H. Lo, B.G. Evans, E. Reinisch, and C. Carignan, What French speakers' nasal vowels tell us about anticipatory nasal coarticulation. *Proceedings of the 20th International Conference of the Phonetic Sciences, Prague, 2023*.
- [15] Pouplier, M., F. Rodriguez, R. Alderton, J.H. Lo, B.G. Evans, E. Reinisch, and C. Carignan, The window of opportunity: Anticipatory nasal coarticulation in three languages. *Proceedings of the 20th International Conference of the Phonetic Sciences, Prague, 2023*.
- [16] Beddor, P.S., J.D. Harnsberger and S. Lindemann, Language-specific patterns of vowel-to-vowel coarticulation: Acoustic structures and their perceptual correlates. *Journal of Phonetics*, 2002. **30**: p. 591-627.