Natalia Kuznetsova
University of Turin / Institute for Linguistic Studies, Russian Academy of Sciences

Production and categorisation of vowel reduction and loss in the Finnic languages of Ingria

Systematic individual variation in speech perception and production produces a pool of variation which becomes the source of language change [1-5]. The change is propagated through the repeated exposure of several generations of learners to a gradually changing variable pool of realisations. Learning is distributional: the learner builds his mental phonological model on the frequency distribution of various phonetic stimuli in the input [6-9]. Language change follows the S-curve path, where a weighting takes one value at the start, and jumps to a different value at some point [10: 293]. The exact mechanism of this jump, as well as the temporal and causal correlation between the change in production and categorisation are, however, still unclear [11: 55, 12: 149, 13: 275].

Typological and theoretical studies on vowel reduction and loss are also still relatively scarce [14-18]. Functionalism links reduction to the low informativity of corresponding pieces of speech and sees it as "part of planned speech behaviour" [19: 132]. Reduction does not affect all vowel qualities or positions equally, nor does it work always in the same direction. Two reduction paths are distinguished: centripetal (centralisation towards *ə*) and centrifugal (dispersion towards the three corner vowels *a, i, u*). These vowels are known to be special in various respects: the most stable and focalised, perceptually salient, the easiest for neural processing [17, 19-22]. There are, however, less data on acoustic and perceptual differences within the corner vowels themselves [22-25].

I discuss the correlation between production and categorisation and the differences between the three corner vowels in a field study on vowel reduction and loss in several endangered Finnic varieties of Ingria (2014-2016). Five varieties were chosen: (1) Kurkola Ingrian Finnish, (2) Luutsa Votic, (3) Central and (4) Sourthern Lower Luga Ingrian, and (5) Siberian Ingrian/Finnish. The last one is spoken in Western Siberia, but originates from Ingria. These varieties represent several subsequent stages of vowel reduction and loss, which includes qualitative and quantitative reduction, devoicing, and speech elision, e.g.: *püssü* [ˈpysːy] > [ˈpysːy̆] > [ˈpysː ̥y̆] > [pysʲʷː] > [pysʲː] > [pysː] 'rifle'. The data were obtained from one speaker per variety, with the exception of South Lower Luga Ingrian (2 speakers). In the phonetic test, open disyllables ending in vowels *a, i, u* (or *o*) after both voiced (*n, l, r, m, v*) and voiceless (*t, k, p, s, h*) singleton consonants were studied in the phrase-initial and the phrase-final position (624 tokens per speaker). The ratios of modal, partially and fully devoiced vowel, aspiration, palatalised/labialised consonant, and zero were subsequently counted, together with qualitative reduction and laryngealisation phenomena. In a parallel categorisation test, the speakers wrote down the carrier words from the phonetic questionnaire (~78) in any preferred orthography the way they perceived them. Neither variety is literary, which allowed to observe more or less direct speakers' intuitions about the presence/absence of a word-final vocalic segment. Main correlations were studied by one-way ANOVA, Levene's, Tamhane's T2 and Games-Howell tests.

Correlated results showed that if a vowel was pronounced >70%, its started loss was typically not yet perceived. After >70% of loss, speakers were not any more aware of the presence of a vowel. A split of 50/50 between the presence and absence of vowel in production correlated to the same split in categorisation. At the beginning of a sound change, the production is more innovative and linked to the automatisation of execution of the old category. At this stage, also the lexical factor is an important player in the distribution of loss, which is concentrated in a few frequent words and grammatical morphemes. At later stages, loss spreads throughout the system and its conditioning becomes purely phonetic. After the reanalysis, when speakers stop perceiving any segment, the categorisation becomes innovative and leads the change, while production lags behind. Reduction is based on a loss of now meaningless low-salience parts, and this last stage can contain near-mergers.

Both centrifugal and centripetal reduction was observed in the data: the rise of mid to high vowels and eventual centralisation of all vowels to schwa, so there is no irreconcilable contradiction between these two paths. Vowel *a* was the most innovative in terms of loss, *u/o* the most conservative, and *i* in the middle. At the same time, consonantal palatalisation was more salient than labialisation, which was in turn more salient than plain aspiration. All these differences are likely to be grounded in acoustic, articulatory and perceptual properties of the three corner vowels.

[1] Baudouin de Courtenay, J. N. (1895). Versuch einer Theorie phonetischer Alternationen: ein Capitel aus der Psychophonetik. Strassurg.

[2] Ohala, J. J. (1989) Sound change is drawn from a pool of synchronic variation. In Breivik, L. E., Jahr, E. H. (eds.). Language change: Contributions to the study of its causes. De Gruyter, 173-198.

[3] Yu, A. C. (2013) Socio-cognitive processing and the actuation of Sound change. Yu, A. C. (ed.). Origins of sound change: Approaches to phonologisation. Oxford University Press, 201-227.

[4] Stevens, M. and Harrington, J. (2014) The individual and the actuation of sound change. Loquens 1(1), e003.

[5] Bybee, J. (2015) Language change. Cambridge University Press.

[6] Maye, J. and Gerken, L. (2000) Learning phonemes without minimal pairs. Proceedings of the Annual Boston University Conference on Language Development 24(2), 522-533.

[7] Vallabha, G. K., McClelland, J. L., Pons, F., Werker, J. F. and Amano, S. (2007) Unsupervised learning of vowel categories from infant-directed speech. Proceedings of the National Academy of Sciences 104(33), 13273-13278.

[8] Wanrooij, K., Escudero, P. and Raijmakers, M. E. (2013) What do listeners learn from exposure to a vowel distribution? An analysis of listening strategies in distributional learning. Journal of Phonetics 41(5), 307-319.

[9] Olejarczuk, P., Kapatsinski, V. and Baayen, R. H. (in press) Distributional learning is error-driven: The role of surprise in the acquisition of phonetic categories. Linguistics Vanguard.

[10] Blythe, R. A. and Croft, W. (2012) S-curves and the mechanisms of propagation in language change. Language 88(2), 269-304.

[11] Bybee, J. (2001) Phonology and language use. New York: Cambridge University Press.

[12] Kirby, J. P. (2010) Cue selection and category restructuring in sound change. PhD thesis. University of Chicago.

[13] Kapatsinski, V. (2018) Changing minds changing tools: From learning theory to language acquisition to language change. MIT Press.

[14] Lindblom, B. (1963) Spectrographic study of vowel reduction. The journal of the Acoustical society of America 35(11), 1773-1781.

[15] Lindblom, B. (1990) Explaining phonetic variation: A sketch of the H&H theory. Hardcastle W. J., Marchal A. (eds.). Speech production and speech modelling. Springer, Dordrecht, 403-439

[16] Flemming, E. (2004) Contrast and perceptual distinctiveness. In B. Hayes, R. Kirchner & D. Steriade (eds.). Phonetically-based phonology. Cambridge: Cambridge University Press, 232-276.

[17] Crosswhite, K. (2004) Vowel reduction. In B. Hayes, R. Kirchner and D. Steriade (eds.). Phonetically-based phonology. Cambridge: Cambridge University Press, 191-231.

[18] Barnes, J. (2006) Strength and weakness at the interface: Positional neutralisation in phonetics and phonology. Mouton de Gruyter.

[19] Harris, J. (2005) Vowel reduction as information loss. In Carr, P., Durand, J., Ewen, C. J. (eds.). Headhood, elements, specification and contrastivity: Phonological papers in honour of John Anderson. John Benjamins Publishing, 119-132.

[20] Polka, L. and Bohn, O. S. (2011) Natural Referent Vowel (NRV) framework: An emerging view of early phonetic development. Journal of Phonetics 39(4), 467–478.

[21] Johnson, K. (2015) Vowel perception asymmetry in auditory and phonemic listening. UC Berkeley Phonology Lab Annual Report 2015. <https://escholarship.org/uc/item/21t337g>.

[22] Manca, A. D., Grimaldi, M. (2016) Vowels and consonants in the brain: Evidence from magnetoencephalographic studies on the N1m in normal-hearing listeners. Frontiers in Psychology 7, 1413.

[23] Traunmüller, H. and Öhrström, N. (2007) Audiovisual perception of openness and lip rounding in front vowels. Journal of Phonetics 35(2), 244-258.

[24] Eulitz, C. and Obleser, J. (2007) Perception of acoustically complex phonological features in vowels is reflected in the induced brain-magnetic activity. Behavioral and Brain Functions 3(1), 26.

[25] Vatakis, A., Maragos, P., Rodomagoulakis, I. and Spence, C. (2012) Assessing the effect of physical differences in the articulation of consonants and vowels on audiovisual temporal perception. Frontiers in integrative neuroscience 6. <doi: 10.3389/fnint.2012.00071>.