

Relating perception and production in contact-induced change

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Recent work has established that phonological contrasts are often gradient rather than categorical (e.g., Hall, 2013). One source of this gradience comes from emergent contrasts, such as those created during language change. Here we consider the relation between perception and production in contrasts introduced through borrowing. While there is evidence for perception leading internal sound change (Coetzee, Beddor, & Wissing, 2014; Harrington, Kleber, & Reubold, 2008; Janson, 1983; Pinget, 2015), little is known about the role of perception in *contact*-induced phonological change. In the present study, we explore the loanword adaptation process, taking a contact-induced case of phonological emergence in Dutch as an example.

The Dutch stop inventory contrasts prevoiced from voiceless stops both initially and medially, but not at all places of articulation. Indeed historically, Dutch has lacked the phoneme /g/. Recently, however, many words have been borrowed from neighboring languages, including over 1,300 from English (van der Sijs, 2002), and this heretofore foreign sound has been creeping its way into the language, to the extent that now even a minimal pair between native /k/ and emerging /g/ exists: /ko:l/, *cabbage* ~ /go:l/, *goal*.

Previous research on the loan phoneme /g/ in Dutch has indicated regional variation in its production (van Bezooijen & Gerritsen, 1994; van de Velde & van Hout, 2002), but these studies have only considered a handful of loan words, with a reduced set of speakers. We therefore began our investigation by exploiting the *Corpus Gesproken Nederlands* (Oostdijk, 2000), a large corpus of spoken Dutch. We extracted a total of 634 tokens of 49 loan words produced by 355 speakers (211 men) from all over the Low Countries. We found a significant correlation between population density of a region and the proportion of use of the new phoneme in loanword productions there ($z = 5.68, p < 0.0001$).

We then tested 51 participants at the University of Utrecht¹. They performed both a production and a perception task. For production, they read aloud sentences containing target words with /g/. A total of 12 target sentences were intermixed with 48 filler sentences (all of which contained loanwords). We found that, in line with the corpus data, the population of the hometown of our participants significantly predicted their /g/ usage ($\chi^2(1) = 25.1, p < 0.0001$). Additionally, we performed phonetic analyses on our participants' productions and found that their average VOT for [g] tokens significantly predicted their /g/ usage ($t = -2.80, p < 0.01$); this is shown in Figure 1. Specifically, we consider that more negative VOT (longer prevoicing) indicates a stronger contrast of the emerging sound with the native /k/ category (which is produced without prevoicing). This result indicates a relationship between speakers' ability to produce the emerging sound (and thus contrast it in production from native [k]) and their overall use of the new sound, with participants who produce "better" [g] also using it more frequently.

For perception, participants performed an ABX discrimination task where they were tested on their perception of the native /p/~b/ contrast compared to the emerging /k~/g/ contrast (note that both are voicing contrasts); five participants were excluded because they performed at less than 80% accuracy on the native contrast. For the remaining participants, accuracy was very high overall but higher for the native than for the emerging contrast (native: 95%, emerging: 91%; $\beta = -0.42, SE = 0.21, \chi^2(1) = 34.1, p < 0.0001$).

Finally, in order to investigate the relation between perception and production, we compared each participant's performance across the two tasks. We extracted the residuals

¹ The University of Utrecht is located in the region with the highest /g/ usage in the corpus.

from a regression of participants' performance in the two conditions of the ABX task, allowing us to have one summary data point per participant (DeGutis, Wilmer, Mercado, & Cohan, 2013). Using this method, a higher residual indicates better perception of the emerging contrast relative to the native contrast, while a lower residual indicates worse perception of the emerging contrast. We used these summary data points to predict participants' individual proportion of /g/ usage and found a significant correlation between the two ($t = 3.26$, $p < 0.01$); this can be seen in Figure 2. This indicates that participants who perceived the contrast better also produced it more frequently.

To summarize, the results from our corpus study and production task show abundant evidence for the representation of emerging /g/ in Dutch speakers. Furthermore, the production of /g/ seems to be modulated by participants' ability to *perceive* the contrast. Further investigation into the underlying mechanisms of this variability is required to assess why certain participants performed better than others in the perception task.

Overall, our results suggest that the emerging sound /g/ has become well anchored in Dutch, with listeners both perceiving and producing it in contrast with native /k/, though this may be modulated by region of origin. We will discuss social and linguistic factors that might contribute to this change, and specifically potential sources of regional variation as observed in our exit questionnaire.

Figures

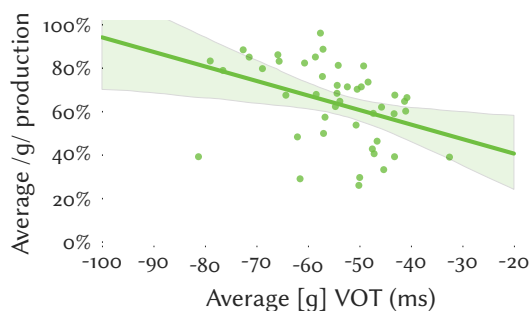


Figure 1: Regression of participants' average /g/ production as a function of their average VOT for [g] tokens.

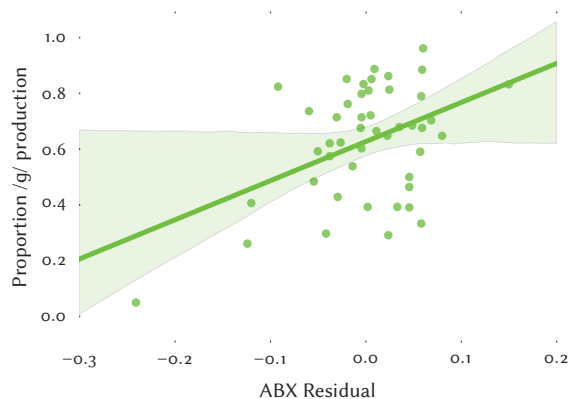


Figure 2: Proportion of /g/ production as a function of participants' extracted residual from the ABX task. Higher residuals indicate better perception of the emerging contrast.

References

- Coetzee, A. W., Beddor, P. S., & Wissing, D. P. (2014). Emergent tonogenesis in Afrikaans. *The Journal of the Acoustical Society of America*, 135(4), 2421–2422.
- DeGutis, J., Wilmer, J., Mercado, R. J., & Cohan, S. (2013). Using regression to measure holistic face processing reveals a strong link with face recognition ability. *Cognition*, 126(1), 87–100. <http://doi.org/10.1016/j.cognition.2012.09.004>
- Harrington, J., Kleber, F., & Reubold, U. (2008). Compensation for coarticulation, /u/-fronting, and sound change in standard southern British: an acoustic and perceptual study. *The Journal of the Acoustical Society of America*, 123(5), 2825–2835. <http://doi.org/10.1121/1.2897042>
- Janson, T. (1983). Sound change in perception and production. *Language*, 59(1), 18–34.
- Oostdijk, N. (2000). The Spoken Dutch Corpus: Overview and first evaluation. *Proceedings of Second International Conference on Language Resources and Evaluation (LREC)*, 887–894.
- Pinget, A.-F. (2015). *The actuation of sound change*. Universiteit Utrecht.
- van Bezooijen, R., & Gerritsen, M. (1994). De uitspraak van uitheemse woorden in het Standaard-Nederlands: een verkennende studie. *De Nieuwe Taalgids*, 87(2), 145–161.
- van de Velde, H., & van Hout, R. (2002). Uitspraakvariatie in leenwoorden. *NVT-Onderwijs En -Onderzoek in Franstalig Gebied*, 1, 77–95.
- van der Sijs, N. (2002). *Chronologisch woordenboek: de ouderdom en herkomst van onze woorden en betekenissen* (2nd ed.). Amsterdam: Lj Veen.