Polysemy and acoustic duration: Different senses come with different durations

Background: Research on lexical ambiguity and phonetic realisation has shown that morphological differences in homophonous elements influence fine-phonetic detail. For example, different types of word-final /s/ in English and German [e.g. 1, 2, 3] affect subphonemic acoustic duration, a finding accounted for by the discriminative lexicon model [DLM; 4, 5]. However, almost all studies in this area focus on homonymy, while polysemy has only recently been examined in this context. [6] found that in a reading task, speakers produced the word-final *-er* suffix (/ɐ/) significantly shorter when producing the gender-specific sense of a masculine role noun in German as opposed to its generic sense counterpart. The present study a) extends this research by finding similar durational differences using more natural speech showing that the effect is robust and not a mere artefact of the reading task, and b) analyses found durational differences using the DLM.

Method: The phonetic realisation of generic and gender-specific masculines was examined using a recall task. The 20 target items (10 female, 10 male stereotypicality; adopted from [6]) all ended in *-er* and appeared in context sentences. Each context was preceded by a sentence introducing a referent and followed by a question (cf. Example 1, referent in italics, target in bold). Gender-specificity was controlled via referent names: female-associated names for generic, male-associated for gender-specific masculines.

1. Das ist *Jenny* / *Jannis*. *Jenny* / *Jannis* ist **Kranführer** beim Bau. Was ist *Jenny* / *Jannis*?

   This is *Jenny* / *Jannis*. *Jenny* / *Jannis* is a **crane operator** in construction. *Jenny* / *Jannis* is what?

Participants first read the introduction and target sentence, accompanied by gender-matching comic-style portraits. After clicking *Ton aufnehmen* 'record sound', only the portrait remained and a question appeared, prompting recall. Figure 1 illustrates the trial structure. Trials were fully randomised, and the experiment was self-paced, with 210 native German speakers (70 speakers x 3 counterbalanced groups) recruited via Prolific. The experiment ran on *PennController for IBEX* [7], and participants received £8.5 per hour. The data ($n = 1790$) after excluding production errors, stuttering, and laughter were analysed using linear mixed-effects regression in R following standard procedures [8]. Models included either *sense* or DLM measures as the predictors of interest and control variables based on related homonymy research [1, 2, 3].

Results: The effect of *sense* showed that generic masculines come with significantly longer /ɐ/ durations than gender-specific masculines ($p < 0.001$, $\eta^2 = 0.32$ with 95% $CI = [0.29, 1.00]$). DLM measures show that the generic sense comes with lower levels of semantic co-activation, which in turn leads to longer acoustic durations ($p < 0.001$, $\eta^2 = 0.58$ with 95% $CI = [0.36, 1.00]$). See Figure 2 for both effects.

Discussion: In recalled as in read speech, generic and gender-specific masculines show significantly different /ɐ/ durations, with the suffix being longer in the generic sense. Since this pattern occurs across tasks, it cannot be attributed to reading or recall alone. The DLM offers a first explanation: generic masculines involve less semantic co-activation in the mental lexicon, resulting in longer acoustic durations. Importantly, not only homonymy but also polysemy appears to affect fine-phonetic detail.

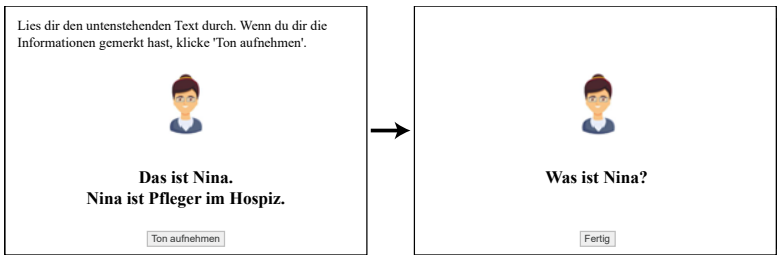

Figure 1: Trial structure: The left screen introduces Nina and provides information on her; the right screen asks about the given information. Left screen, top: Please read the text below. Once you memorised the information, please click on 'record sound'. Left screen, bottom: This is Nina. Nina is a nurse at the hospice. Left screen, button: Record sound. Right screen: Nina is what? Right screen, button: Done.

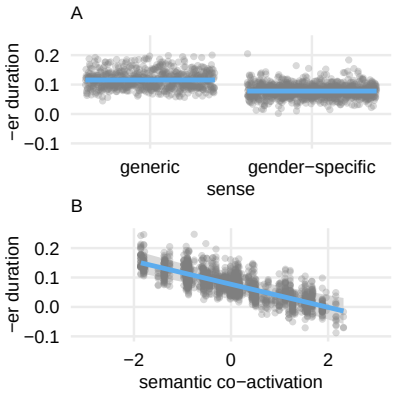

Figure 2: Partial effects of *sense* (A) and *semantic co-activation* (B) as predicted by the linear mixed-effects models.

References

[1] Plag, I., Homann, J., & Kunter, G. (2017). Homophony and morphology: The acoustics of word-final S in English. *Journal of Linguistics*, *53*(1), 181–216. https://doi.org/10.1017/S0022226715000183

[2] Schmitz, D., Baer-Henney, D., & Plag, I. (2021). The duration of word-final /s/ differs across morphological categories in English: Evidence from pseudowords. *Phonetica*, *78*(5-6), 571–616. https://doi.org/10.1515/phon-2021-2013

[3] Schmitz, D., & Baer-Henney, D. (2024). Morphology renders homophonous segments phonetically different: Word-final /s/ in German. *Proceedings of Speech Prosody 2024*, 587–591. https://doi.org/10.21437/SpeechProsody.2024-119

[4] Baayen, R. H., Chuang, Y.-Y., Shafaei-Bajestan, E., & Blevins, J. P. (2019). The discriminative lexicon: A unified computational model for the lexicon and lexical processing in comprehension and production grounded not in (de)composition but in linear discriminative learning. *Complexity*, *2019*, 4895891. https://doi.org/10.1155/2019/4895891

[5] Schmitz, D., Plag, I., Baer-Henney, D., & Stein, S. D. (2021). Durational differences of word-final /s/ emerge from the lexicon: Modelling morpho-phonetic effects in pseudowords with linear discriminative learning. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.680889

[6] redacted. (forthcoming). Homophonous semantic minimal pairs differ in their subphonemic acoustic durations: The case of generic and specific masculines in German. *Proceedings of 20. Phonetik und Phonologie Tagung*.

[7] Zehr, J., & Schwarz, F. (2018). PennController for internet based experiments (IBEX). https://doi.org/10.17605/OSF.IO/MD832

[8] Baayen, R. H., & Milin, P. (2010). Analyzing reaction times. *International Journal of Psychological Research*, *3*(2), 12–28. https://doi.org/10.21500/20112084.807