

# Compensation for Assimilatory Devoicing and Prosodic Structure in German Fricative Perception

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## Résumé:

*Cette communication étudie la question de savoir comment des auditeurs perçoivent des fricatifs qui sont aphones à cause d'assimilation, processus conditionné par la structure prosodique et par des contraintes phonotactiques. Trois expériences d'identification de phonèmes ont montré que les écouteurs compensent pour l'assimilation dans des contextes segmentales viables, et que cette compensation est modulée par la structure prosodique lorsque la phonation signale des contrastes lexicaux fonctionnels.*

Among the many reasons for phonetic variation, major intralinguistic sources are coarticulatory and assimilatory processes, and prosodic structure. Recently, the influence of prosodic structure on the fine-grained phonetic detail of segment realization has been shown for a substantial number of languages. In particular, segments in domain-initial position are articulated with greater spatio-temporal expansion, the higher the prosodic domain (e.g., Keating et al. 2003; Fougeron 2001). In addition, prosodic structure has long been known to constrain phonological processes, such as assimilation (e.g., Nespor & Vogel 1986). These phonological processes are more frequent across lower prosodic boundaries, such as word boundaries.

A previous study in speech production (Kuzla & Cho 2004) has demonstrated prosodically-conditioned gradedness in the progressive voice assimilation of German fricatives: More assimilatory devoicing of word-initial lax fricatives /v, z/ following a voiceless obstruent was observed across word boundaries than across phrase boundaries.

The present study investigates the effects of voice assimilation and prosodic structure on the perception of German fricatives. Crucially, prosodic strengthening and assimilatory devoicing affect two important acoustic cues to the fortis-lenis distinction, duration and vocal fold vibration, and may thus affect the phonemic contrast in minimal pairs such as /vɛldə/ 'forests' and /fɛldə/ 'fields'. Numerous studies have shown that listeners may compensate for assimilation and coarticulation by adjusting phoneme categories to different contexts (e.g., Gow 2001; Fowler 2005; Mitterer & Blomert 2003). In the case of German fricatives, compensation would imply that less vocal fold vibration is required for a lenis judgement in a viable assimilation context (/t/) than in a non-viable context (/ə/). It has not yet been investigated whether compensation for assimilation is influenced by prosodic structure, although, as just noted, prosodic structure moderates the degree of assimilation in speech production. If prosodic structure plays a role in compensation, less vocal fold vibration should be necessary for a lenis judgement in assimilation contexts across a prosodic word boundary, where segments are more devoiced due to assimilation, than across a phrase boundary.

We tested these two hypotheses in three phoneme categorization experiments. Listeners identified test sounds from voicing continua as /v/ or /f/, that is, as the initial segment of the target words /vɛldə/ or /fɛldə/ in semantically unbiased full-utterance contexts (e.g., *Anna hatte [?]elder und Seen gemalt*, 'Anna had been painting forests/fields and lakes'). In all experiments, there were four conditions: two prosodic boundaries (Word, Phrase) crossed with two segmental contexts (assimilation context /t/, non-assimilation context /ə/).

In the first experiment, two 7-step continua were generated by varying the amount of vocal fold vibration during the labiodental lax fricative /v/ from 0% to 85%. Since prosodic structure affects segment duration, durations differed between the two prosodic conditions (50ms for the Word condition and 70 ms for the Phrase condition). Identification of the fricatives as lax /v/ or tense /f/ was influenced by context in the predicted direction, with more /v/ responses in the assimilation context /t/. The effect of prosodic structure did not reach

significance in the /t/-context. Possibly, this reflects a ceiling effect: Nearly all stimuli in this context were already perceived as /v/. This may be due to a general bias towards /v/ in the stimuli resulting from the relatively short durations of the test sounds, which were appropriate for lenis fricatives.

A second experiment therefore used a continuum with natural /f/ and /v/ endpoints, in which the amount of glottal vibration covaried with duration. This experiment replicated the finding of compensation for assimilation, that is, it yielded more /v/-responses in /t/-context. In this second experiment, this compensation was prosodically moderated: Listeners gave more /v/-responses after prosodic word boundaries than after phrase boundaries. These results suggest that listeners have learnt how prosodic structure affects the fine phonetic details of assimilated segments, and that prosodic structure therefore influences their compensation for assimilation.

In a third experiment, we tested a /s-z/ continuum in the same way as the /f-v/ continuum in Experiment 2. Whereas initial /f/ and /v/ distinguish between words, the /s-z/ contrast is not lexically functional in word-initial position in German, where /s/ is phonotactically illegal. This difference in functional load leads to greater variability in production and to more assimilatory devoicing of /z/ compared to /v/. Also in this third experiment, listeners compensated for assimilation, that is, they gave more /z/-responses in /t/-context than in /b/-context. They did not exploit the differences in degree of assimilation induced by prosodic structure.

In summary, the findings of this study show that listeners compensate for assimilatory devoicing of fricatives. This compensation is moderated by prosodic structure, which is known to affect the amount of assimilatory devoicing. The effect of prosodic structure, however, appears to be restricted to existing lexical contrasts.

## References

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