

Pretonic schwa reduction in Dutch: Frequency effects interact with phonotactics

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Abstract

Word frequency plays a role in reduction processes: high-frequency words undergo more reduction than low-frequency words. Pretonic schwa reduction in Dutch is susceptible to frequency effects in this way, but the well-formedness of the cluster that remains after schwa deletion also plays a role. An experiment shows that cluster well-formedness and frequency effects in fact interact with each other. This suggests that phonological models should incorporate both lexical as well a grammatical information.

Key words: Frequency effects, phonotactics, pretonic schwa, reduction.

Introduction

It has been observed for Dutch, that schwa deletion is more likely to be applied, when the resulting consonant cluster consists of an obstruent and subsequent liquid (Booij 1995). Thus all other things being equal, *gelijk* [χə 'leɪk] 'even' is expected to undergo schwa deletion more often than *geniep* [χə 'ni:p] 'mean', because in Dutch χl is a well-formed cluster but χn is not. However, pretonic vowels in Dutch are also known to be more reduced in high-frequency (HF) words than in low-frequency (LF) words (van Oostendorp 1999). This raises the question of whether frequency effects interact with the well-formedness of the cluster that remains after deletion. Is it the case that frequency effects are only found in potential well-formed onset clusters? Or is it rather the case that schwa reduction in consonant-liquid clusters is dependent on word frequency? How does frequency interact with phonotactics exactly?

To investigate the effect of cluster well-formedness (CWF) and frequency, a word reading task was carried out. HF and LF words were extracted from Corpus Gesproken Nederlands (Spoken Dutch Corpus) available on www.tst.inl.nl and from the CELEX database on www.celex.mpi.nl. Each HF word with the context CəC- was matched with an LF word following a number of criteria: the consonants preceding the schwa and following the schwa were identical, the number of syllables was identical, the number of phonemes was matched as much as possible and stress placement was identical.

The corpus frequency counts may deviate from the frequency of the individual lexicon of the subjects. It is well-known in psycholinguistics that word frequency is related to naming latency, in the sense that HF words have shorter latencies than LF words (Oldfield & Wingfield 1965,

Jescheniak & Levelt 1994, among others). In order to ensure that the selection on the basis of frequency was justified, naming latencies were measured.

Methodology

Stimuli

Stimuli were selected on the basis of their frequency and the CWF. LF words had an occurrence of less than 10 per million and HF words occurred at least 100 times per million. Eight pairs of HF words and LF words were selected with possible target clusters /χl, bR, bl, vR/ and eight pairs of HF words and LF words were selected with impossible clusters {bχ, bd, bn, bz, dz, χm, χn, χv, χv}. In all, 32 critical stimuli were collected and 48 words were used as fillers, which were pseudo randomized.

Subjects

Twenty participants, mostly undergraduate and graduate students of Leiden University Linguistics Department, took part in the experiment. The group of subjects consisted of 13 females and 7 males. All of them were native speakers of Dutch. All subjects had normal or corrected-to-normal vision. The subjects took part voluntarily and were not paid for their participation.

Procedure

The subjects were individually recorded in an isolated booth. They received instructions from the experimenter and via a computer screen to quickly read aloud the words presented. The stimuli were made visible on a computer screen for 500 ms, followed by an interval of 1000 ms. The 80 stimuli were presented ten times in different orders. The order of the blocks was fully randomised. The naming latency was measured, making use of E-Prime standard 2.0. Each session was recorded with a *Sennheiser* MKH 416 directional condenser to a Marantz recorder. The computer was placed outside the booth. The experimenter was present to ensure that the experiment was carried out in the expected way. Schwa durations were measured in Praat (Boersma & Weenink 2001), measurements shorter than 10 ms were treated as deletions.

Results

Reaction times were measured to ensure that the selection of HF and LF words for individual subjects was justified. A t-test confirmed the justification of the selection except for one subject, so her responses were excluded from further investigation. Secondly, deletion of schwa was calculated. The number of deletions increases with repetition of the stimuli, but no higher tendency for deletion in HF words or well-formed clusters was detected.

Table 2. Percentages and number of schwa deletions based on the four stimuli groups

WordGroup	Deleted schwa		Undeleted schwa		Total	
	Perc	N	Perc	N	Perc	N
cluster ill-formed LF	11.1%	122	88.9%	982	100%	1104
cluster ill-formed HF	10.2%	113	89.8%	999	100%	1112
cluster well-formed LF	16.8%	187	83.2%	926	100%	1113
cluster well-formed HF	14.4%	140	85.6%	832	100%	972

So deletion does not seem to play a role: possibly deletion has to be treated as an extremely reduced form. To analyse the relative importance of the predictors, a regression test on WFC, frequency, repetition and the number of syllables showed a positive correlation ($R = 0.327$, $F=46.052$, $p=0.000$). The factors that significantly contribute to the variation effects were repetition ($t=-8.585$, $p<0.001$) and CWF ($t=-10.215$, $p<0.001$). Frequency effects were not found, probably due to overshadowing of repetition effects, since both are essentially a matter of activation. Therefore I conducted an ANOVA on the first block of stimuli only. The main effect of CWF was $F=32.437$, $p=0.000$. Although no main effect of frequency was attested, there was a significant interaction between CWF and frequency ($F=5.188$, $p=0.040$).

The diverging lines of the interaction diagram (Figure 1) show that the difference in duration between well-formed target onset clusters and ill-formed target onset clusters is relatively small in LF words, whereas it is larger for HF words. This means that HF words show more variation in schwa duration under the influence of phonotactic well-formedness of the cluster than LF words. Put differently, HF words are more sensitive to cluster well-formedness than LF words in reduction. Notice that it is not necessary for the schwa to be deleted for this interactional effect to occur.

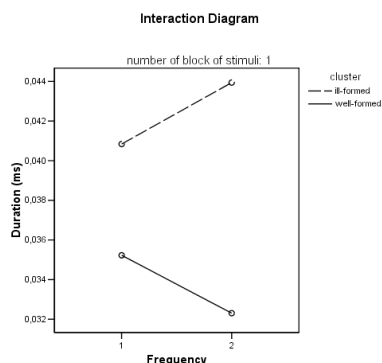


Figure 1. The interaction in pretonic schwa duration between frequency (1=LF, 2=HF) and well-formedness of the cluster.

Discussion and conclusion

The results of this experiment showed that word frequency interacts with phonological grammar such that high frequency words are more sensitive than low-frequency words to reduction under the influence of the well-formedness of the cluster that would remain after full deletion. This interaction must have consequences for phonological theory, since frequency effects and grammar are usually treated separately. Frequency effects have been modelled in Optimality Theory (see the work of Boersma 1998 seq. and Coetzee 2008), but not in direct connection to grammatical structure. Since frequency information is fundamentally lexical rather than grammatical, the interaction found in this experiment confirms that modelling on the basis of a grammar as well as a lexicon (as suggested by Ernestus 2009 and van de Weijer 2009, 2011) is on the right track.

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