REGRESSIVE VOICE ASSIMILATION IN SWEDISH [1]

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ABSTRACT

This paper examines the occurrence of regressive voice assimilation in Swedish. Six speakers of Central Standard Swedish were recorded and the voicing conditions in stop-fricative and stop-stop clusters were analyzed. The findings indicate that regressive devoicing of lenis stops (/b d g/) occurs only when followed by /t/, but not /s/. This contradicts claims in the literature regarding the nature of regressive voice assimilation in Swedish. These findings also demonstrate the necessity of doing detailed acoustic analysis of stop production in order to ascertain the details of the phonological distribution of stop variants.

Keywords: Swedish, stop production, phonetic or phonological devoicing, regressive assimilation.

1. INTRODUCTION

In the literature of generative phonology, there has been considerable interest in the question of what features are involved in laryngeal contrasts and what types of assimilation occur in the languages of the world. With very few exceptions, discussions have been based on impressionistic transcriptions or on accounts that do not give clear indication of what the phonetic facts are. Often, when careful acoustic and phonological studies are done, it turns out that the data are quite different from those that have been repeatedly analyzed in the phonological literature. Consider the case of German. In the phonological literature, Cho [2] and Lombardi [6], among others, claim that German word internal clusters may contain stops that disagree in voice (with the second stop being voiced). Yet careful acoustic analysis [5] shows clearly that all such clusters are voiceless (either with or without aspiration) in German.

In this paper we address the case of Swedish, and in particular whether (regressive) devoicing of stops occurs before /s/, but we present data on regressive devoicing of stops in clusters of stops as well. (We do not consider progressive devoicing of stops that occurs in clusters and which is well-documented [8]). Various conflicting claims about regressive assimilation to voicelessness are found in the literature, including those by Anderson [1], Cho [2], and Lombardi [6]. In fact, all of these works are based on different interpretations of claims made by Hellberg [4] and Lyttkens & Wulff [7]. Lombardi, for example, claims that the genitive /s/ causes the devoicing of a preceding voiced stop. Cho, on the other hand, claims that there is no phonological devoicing preceding genitive and passive /s/. Instead, she suggests that the devoicing is only partial and conditioned by phonetic context. She claims, in fact, that *all* putative regressive devoicing in Swedish (e.g., of /g/ in /vɛ:g+t/ 'weighed SUP' and /vɛ:g+s/ 'weigh PASS') is phonetic as well (i.e., only partial devoicing).

The results of the present experiment show that none of these claims are phonetically accurate. We found that /t/ and /s/ differ in how they affect a preceding stop: stops that are voiced when followed by a voiced segment (or a pause) are also voiced if an /s/ follows, but voiceless if a /t/ follows. Morpheme-internal /dk/ clusters did not have regressive devoicing which suggests that fortis stops do not trigger regressive devoicing morpheme internally.

In the following section we describe the experimental set-up and speech materials. The results are discussed in section 3. Section 4 contains conclusions.

2. METHOD

Six subjects, three male and three female, were recruited for the experiment. The male subjects were JW, NO and PL (all in their twenties). The female subjects were SU (in her twenties), JU (early thirties) and GT (late forties). All the subjects identified themselves as speakers of the Central Standard variety of Swedish, and have lived in Central Sweden (specifically in Stockholm and/or

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Uppsala) for most or all of their lives. All subjects reported having normal hearing. The subjects were paid for participating in the experiment.

The subjects were recorded in a sound-treated room at the Stockholm University phonetics laboratory. A Brüel & Kjær 4145 microphone was used, placed in front of the speaker at a distance of approximately 35 cm. The signal was recorded at 44.1 kHz and downsampled to 16 kHz. The durational analysis was performed using the WaveSurfer software package [9].

The subjects read a list of sentences, partial sentences and isolated words. The list was read twice. The aim was to elicit words in which stops (lenis and fortis) were followed by either a /t/ (supine or neuter sg. adjective/past participle) or /s/ (genitive or passive voice). For pragmatic reasons, a full or partial sentence context was needed to elicit the /s/ clitic. This yielded sentences and partial sentences such as:

Ett bröds bäst-före-datum måste stå på paketet.
A bread-GEN best-by-date must be on package-DET

…ett bröds bäst-före-datum…
…a bread-GEN best-by-date…

Words with the suffix /t/ were elicited predominantly using a simple word list, in which the target words were presented in isolation on separate lines interspersed with fillers. Only words with a velar stop followed by a suffix /t/ were considered.

A total of 30 tokens with /p t k/ + /s/ were elicited for each subject; for ease of reference these will henceforth be referred to as *bröts* words (*bröts* 'broke-PASS'). For /k/ + /t/ 16 tokens were elicited; these will be referred to as *sökt* words (*sökt* 'search-SUP'). For /b d g/ + /s/ 30 tokens were elicited; these will be referred to as *bröds* words (*bröds* 'bread-GEN'). For /g/ + /t/, 16 tokens were elicited; these will be referred to as *trögt* words (*trögt* 'slow-SG-NEUT').

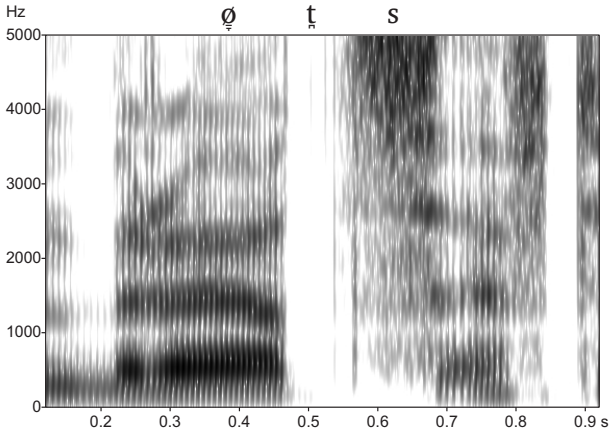
Three words which contain a morpheme-internal /dk/ cluster were also included in the list, yielding a total of 6 tokens for each speaker; these will be referred to as *blidka* words (*blidka* 'soften').

Voice offset time was used as a measure of the degree of voicing for stops preceding /s/ or /t/. Voice offset time (VOffT) was measured by determining the offset of modal voicing in the sequence of vowel + stop + stop/fricative relative to the onset of stop closure. For example, if modal voicing ceases 15 ms before the stop closure occurs, VOffT is −15 ms. If voicing ceases 60 ms after the stop closure occurs, VOffT is 60 ms.

3. RESULTS

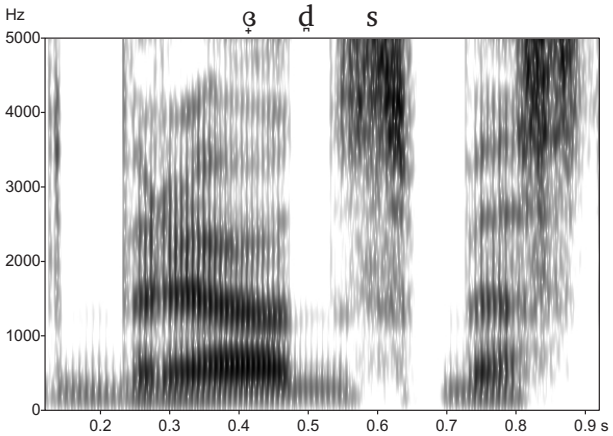
For all subjects fortis stops were generally voiceless preceding both /t/ and /s/ (i.e. in *sökt* and *bröts* words). Typically voicing ceased at approximately the same time as the stop closure was made, as in the example in Figure 1.

Figure 1: The word *bröts* /brø:t+s/ 'broke-PASS' produced in a sentence context by subject PL.



In *bröds* words, voicing was typically present throughout the closure phase of the /d+s/ sequence, as in the example in Figure 2.

Figure 2: The word *bröds* /brø:d+s/ 'bread-GEN' produced in a sentence context by subject PL.



In *trögt* words, however, the stop closure was generally voiceless, as in the example in Figure 3. Impressionistically, stop clusters in these words were indistinguishable from stop clusters in *sökt* words, shown in Figure 4.

Table 1 gives the mean duration of VOffT for the word types in question. There was little differ-

ence in VOffT between /g/ + /t/ and /k/ + /t/ sequences (i.e. *trögt* and *sökt* words; −9.1 ms and −10.7 ms respectively). A two-tailed t-test indicated that this difference was not significant.

Figure 3: The word *trögt* /trø:g+t/ 'slow-NEUT-SG' produced in a sentence context by subject PL.

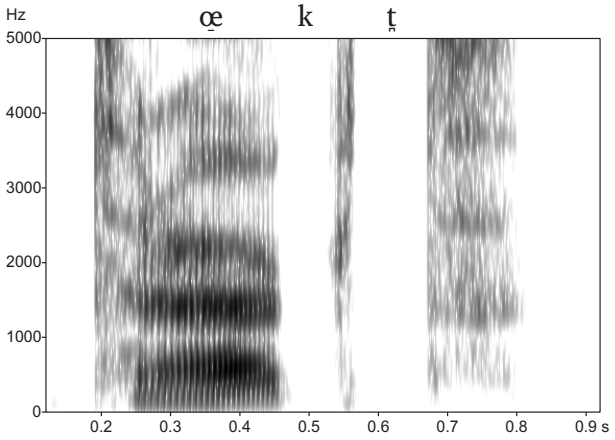
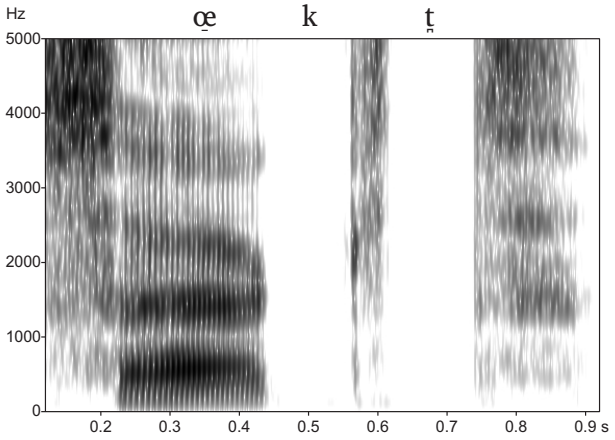


Figure 4: The word *sökt* /sø:k+t/ 'search-SUP' produced in a sentence context by subject PL.



Mean VOffT for *bröds* words was 56.1 ms. For *trögt* words, mean VOffT was −9.1 ms. This difference was highly significant ($p > 0.001$; $t = -21.13$).

Mean VOffT for *bröts* words was −0.2 ms and mean VOffT for *sökt* words was −10.7 ms. This difference most likely reflects a tendency for longer preaspirations before velars than bilabials and dentals in Swedish [3].

The scatterplots in Figure 5 plot VOffT against stop closure duration for all sequence types considered (*trögt*, *bröds* and *blidka* words in Figure 5a and *sökt* and *bröts* words in Figure 5b). Figure 5a shows that the /g/ + /t/ sequences are almost entirely separated from /b d g/ + /s/ sequences when both closure duration and VOffT are considered. This is also true if only /g/ + /s/ sequences are considered, and /b d/ + /s/ sequences are excluded: for /g/ + /s/, Q1 is 43 ms, the median is 58 ms, Q3 is 86 ms and the mean is 62.8 ms. One can also infer from Figure 5a that VOffTs in *blidka* words are similar to those in *bröds* words, although closure durations in *blidka* words are generally greater.

Table 1: Mean VOffT and standard deviation for stops in the sequence types considered.

Sequence	VOffT	StDev
/k/ + /t/ (*sökt* words)	−10.7	14.8
/g/ + /t/ (*trögt* words)	−9.1	20.3
/p t k/ + /s/ (*bröts* words)	−0.2	12.7
/b d g/ + /s/ (*bröds* words)	56.1	30.3
/dk/ (*blidka* words)	56.4	37.3

It is also evident that as closure duration increases, VOffT increases for both *bröds* and *blidka* words. This is not the case in *trögt*, *sökt* and *bröts* words, for which VOffT remains close to 0 irrespective of closure duration.

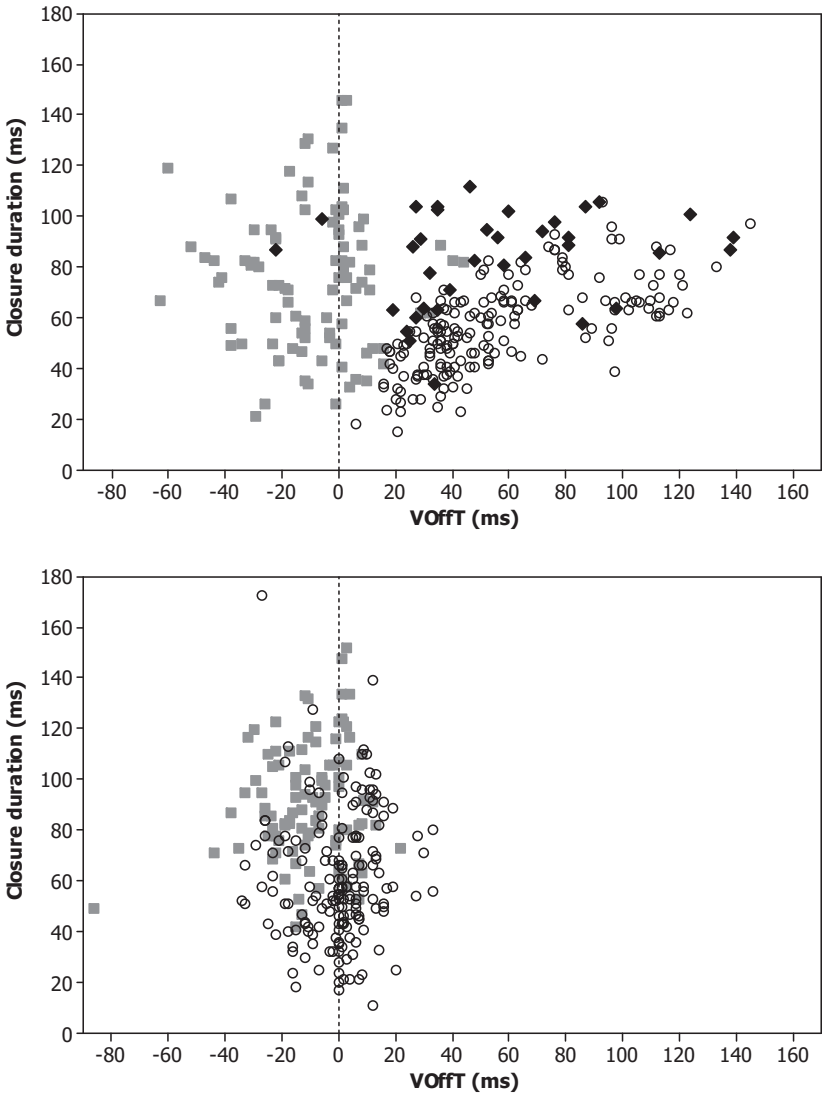
4. CONCLUSIONS

Our results show that there is essentially no consistent regressive voice assimilation before /s/. Our results thus support Cho's [2] claim that any regressive devoicing that occurs before /s/ is phonetic and only partial. On the other hand, our results show that regressive assimilation *does* occur before /t/. Thus, in word forms such as *vägt* 'weigh SUP' (< *vä*/g+t/) we find that, contrary to Cho's claim, the regressive voicing is not partial; rather, when the trigger is a voiceless stop, the entire cluster is devoiced for all speakers. Thus, in *vägt* and similar forms, we find that the cluster is entirely voiceless [kt], indistinguishable from forms such as *vräkt* 'evicted' (< *vrä*/k+t/) with input /kt/.

We conclude that contrary to the claims in the literature, there is regressive devoicing of a stop triggered only by a following voiceless stop, not by a following voiceless fricative. The devoicing that occurs before a fricative is only partial, at best, and does not occur for all speakers. In contrast, the regressive devoicing before a voiceless stop is complete and is found for all speakers.

Our results for Swedish underscore how important careful, acoustic analysis of speech data is for phonological analysis. In the case of Swedish, we find, somewhat surprisingly, that voiceless stops and fricatives do not both condition regressive assimilation in voicelessness. Such information is

Figure 5: Scatterplots of VOffT and closure duration for all stops considered. The upper plot (a) shows observations for words with stem-final lenis stops, i.e. *trögt* words (gray squares) and *bröds* words (unfilled circles), as well as the morpheme internal /dk/ sequences, i.e. *blidka* words (black rhombs). The lower plot (b) shows observations for words with stem-final fortis stops, i.e. *sökt* words (gray squares) and *bröts* words (unfilled circles). The dashed vertical line marks the onset of stop closure.



crucial to a phonological analysis of voice assimilation in Swedish and ultimately to our understanding of the range and variety of voice assimilation systems in the world's languages.

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