CHAPTER 21

The phonological status of schwa insertion in Dutch: An EMA study

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Abstract. Articulatory data are used to address the question of whether Dutch schwa insertion is a phonological or a phonetic process. By investigating tongue tip raising and dorsal lowering, we show that /l/ when it appears before inserted schwa is a light /l/, just as /l/ before an underlying schwa is, and unlike the dark /l/ before a consonant in non-insertion productions of the same words. The fact that inserted schwa can condition the light/dark /l/ alternation shows that schwa insertion involves the phonological insertion of a segment rather than phonetic adjustments to articulations.

1 Introduction

A frequent question in linguistic analyses is whether a particular alternation among sounds is a phonological process, and thus an abstract cognitive process to be described as part of the grammar of a language, or rather a phonetic process, and thus a matter of adjustments to speakers' articulations. The criteria for deciding whether a particular alternation is part of the phonology or of the phonetics are often not clear, and some theorists have disputed the need for such a distinction at all. In this paper, we show how articulatory data can be used to decide whether one alternation, Dutch schwa insertion, is a phonological or a phonetic process.

Dutch schwa insertion is a process by which forms with a cluster of /l/ or /r/ followed by a labial or dorsal consonant are often produced with a schwa between the liquid and the following consonant, as in (1). This alternation is highly variable: although some speakers usually insert the schwa, and some rarely do, many speakers produce words both with and without the schwa quite frequently (Kuijpers & Donselaar, 1998). The alternation is also not sociolinguistically marked. Both forms are heard in informal conversation and such formal speech as newscasts.

(1)	/fɪlm/	[fɪləm]~[fɪlm]	'film'
	/halve/	[haləvə]~[halvə]	'half' (adj.)

We examine two hypotheses for what causes Dutch schwa insertion. First, the insertion of the schwa might be a phonological process. That is, the phoneme /ə/, or perhaps a syllable nucleus position, would be inserted into the underlying form. This /ə/ would then behave as other occurrences of /ə/ in the language, which are always present rather than inserted. This possibility is represented in Figure 1. Alternatively, schwa insertion might be a matter of articulatory timing, that is, of realization of the gestures used to produce the sounds. In this case, it might be that the gestures of the /l/ and the following consonant simply become separated in time, leaving a schwa-like sound between them. This possibility is schematically represented in Figure 2.

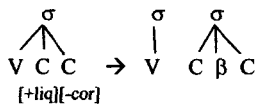


Figure 1: Phonological account

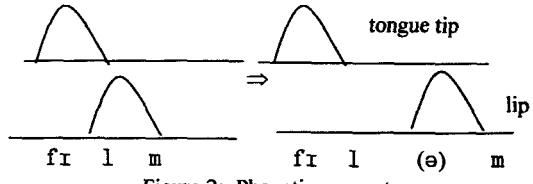


Figure 2: Phonetic account

What makes it possible to distinguish these two hypotheses experimentally is the fact that Dutch has an alternation between dark /l/ in syllable coda position and light /l/ in onset position. Since the articulatory hypothesis in Figure 2 does not involve inserting a vowel as a phonological unit, there is no reason for this hypothesis to predict a change in the articulation of the /l/. The phonetic account would therefore predict that if

/l/ is dark in [fɪlm], it should also be dark in [fɪləm]. The phonological account, on the other hand, involves insertion of a vowel, or a syllable nucleus position, and therefore predicts that /l/ before inserted schwa should be light, just as /l/ before non-inserted vowels is. Recent psycholinguistic research on schwa insertion (Donselaar et al., 1999) has found that /l/ is easier to perceive when words are produced with inserted schwa than without, and has suggested that this might be because /l/ has stronger acoustic cues when in syllable onset position. This would be in accord with the phonological account.

Light and dark /l/ can be distinguished articulatorily: past research on English, which has a similar light/dark /l/ alternation, shows that light /l/ involves greater tongue tip raising than dark /l/ does, while dark /l/ involves greater lowering and/or backing of the dorsum than light /l/ (Sproat & Fujimura, 1993; Gick, 1999). We know of no past research on articulation of light and dark /l/ in Dutch, but it is likely to be similar. We therefore collected articulatory data on the production of /l/ in Dutch before inserted schwa, before schwa which does not stem from insertion, and before consonants in forms without inserted schwa. This allows us to determine whether /l/ before inserted schwa is the same as /l/ before non-inserted schwa (presumably light), or the same as /l/ before consonants (presumably dark), and thus allows us to conclude whether Dutch schwa insertion is a phonological or a phonetic process.

2 Methods

Five Dutch speakers produced 24 words with the environment for schwa insertion (2a) and 24 words with underlying schwa (schwa which is always present and does not arise from insertion (2b)) in a Carstens Articulograph. Speakers were chosen from a larger pool based on variability of schwa insertion, in order to facilitate obtaining productions of the same words with and without inserted schwa from each speaker. Articulograph pellets were placed on the tongue tip, body, and dorsum, as well as on the upper teeth for reference. Each word with the possibility of schwa insertion was placed in two prosodic environments to encourage speakers to produce it both with and without inserted schwa, as in (3) (cf. Kuijpers & Donselaar, 1998). Two recordings of all materials were made for each speaker. In the first recording, no instructions were given about schwa insertion, although the materials were presented in blocks by prosodic environment, and by whether the word had the environment for schwa insertion or had an underlying schwa. In the second recording, speakers were instructed for each block whether to insert the schwa or not. Most speakers had no difficulty in producing words with and without inserted schwa as instructed.

(2a) /[fɪlm]/ 'film' (2b) /wɪləm/ (name)
/dɛlvən/ 'dig' /hɛləvɔrst/ 'Prince of Darkness'

(3) "nieuwe olmen planten" 'plant new elms'
SW SW SW
"droevige ol[ə]men jammeren" 'sad elms moan'
SWW S(W)W SWW

This procedure leads to /l/ appearing in three conditions, as shown in (4), although the number of tokens, particularly for the uninstructed recording, varies. For each production, the height and backness of the tongue tip, body, and dorsum were measured at the time point of the peak of tongue tip raising and at the peak of dorsal backing (Sproat & Fujimura 1993, Browman & Goldstein 1995, Gick 1999). However, because /l/ in our data often follows low back vowels, the peak of dorsal backing for the /l/ was often not distinct from the dorsal backing gesture for the vowel, and thus was not very informative. Therefore we will focus on the data measured at peak of tip raising. The position of the upper teeth (reference pellet) was subtracted from the position of each other pellet at each measurement point in order to correct for small movements of the helmet.

(4) Underlying schwa	Inserted schwa	Preconsonantal (no schwa inserted)
/dɔləmɑn/ [dɔləmɑn] 'madman'	/ɔlmən/ [ɔləmən] 'elms'	/ɔlmən/ [ɔlmən] 'elms'

3 Results

We analyzed several subsets of the data. The first involves comparison only within the instructed recording. This is the most controlled data set, and it includes 15 sets of words (as in (4)) for each speaker. The second is a comparison entirely within the uninstructed recording, to establish whether the same patterns hold when speakers are not informed about schwa insertion. This comparison includes fewer item triples, and productions with and without inserted schwa are not from the same words. The third subset is a direct comparison of /l/ before inserted schwa in the instructed and the uninstructed recording, to confirm that instruction does not influence how schwa insertion is produced.

3.1 Comparison within the instructed recording

For all five speakers, tip raising is significantly greater before inserted schwa than in preconsonantal productions (Figure 3). Lowering of the dorsum is significantly greater for each speaker in preconsonantal productions than before inserted schwa (Figure 4). Differences between /l/ before inserted and underlying schwa are small, of inconsistent direction, and not significant for most speakers. The results show few differences in fronting or backing of either the tip or the dorsum, and those differences are not in a consistent direction across speakers. Thus, /l/ before inserted schwa is similar to /l/ before underlying schwa, and both are light (as indicated by greater tip raising and less dorsal lowering). /l/ before a consonant (no inserted schwa) is different from the other two conditions, and is dark.

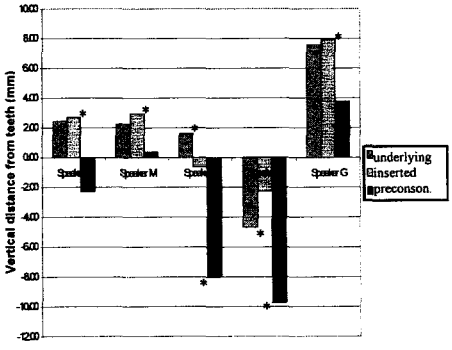


Figure 3: Position of tongue tip relative to the teeth in the vertical dimension, for instructed data.

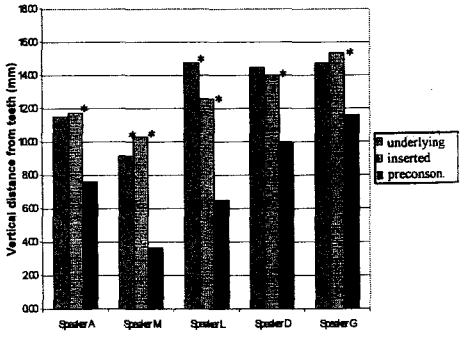
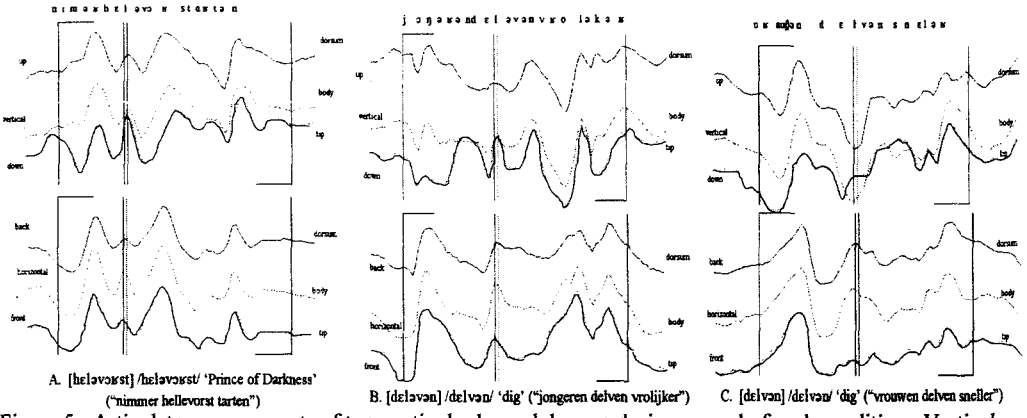


Figure 4: Position of the dorsum relative to the teeth in the vertical dimension, for instructed data.

Figure 5 shows examples of articulatory movements of the tongue tip, body, and dorsum during production of a word in each condition. The large, quick raising of the tongue tip in the underlying schwa and the inserted schwa conditions is typical. In the preconsonantal condition, however, there is slight raising of the tip, but substantial lowering of the body and dorsum.



A. [hɛləvɔʁst] /hɛləvɔʁst/ 'Prince of Darkness' ("nimmer hellevorst tarten")

B. [dɛlәvәn] /dɛlvәn/ 'dig' ("jongeren delven vrolijker")

C. [dɛlvәn] /dɛlvәn/ 'dig' ("vrouwen delven sneller")

Figure 5: Articulatory movements of tongue tip, body, and dorsum during a word of each condition. Vertical lines in the center of each figure indicate peak of dorsal backing (left) and peak of tip raising (right).

3.2 Comparison within the uninstructed recording

For the uninstructed recording, we matched 7-9 sets of words, consisting of similar but not identical words with and without inserted schwa and a word with underlying schwa (5), for each speaker.

(5) [fɪləm] 'film' [fɪlmər] 'cameraman' [wɪləm] (name)
[zɑləm] 'salmon' [zɑlmpjə] 'small salmon' [stɑləm] 'park it'

The results are similar to those from the instructed recording, but somewhat noisier, probably because of the lower number of items. Some differences are only significant for 3 speakers, but in general the pattern of greater

tip raising before both inserted and underlying schwa (Figure 6), and greater dorsal lowering in the preconsonantal condition (Figure 7), persists. This indicates that /l/ before inserted schwa is light even in uninstructed speech.

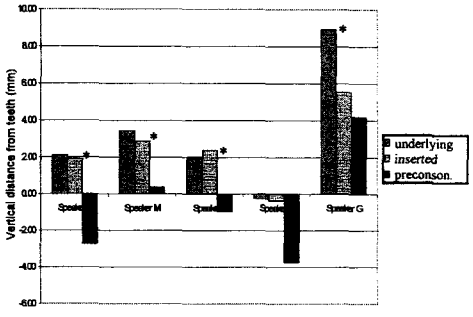


Figure 6: Same as Figure 3, for uninstructed recording.

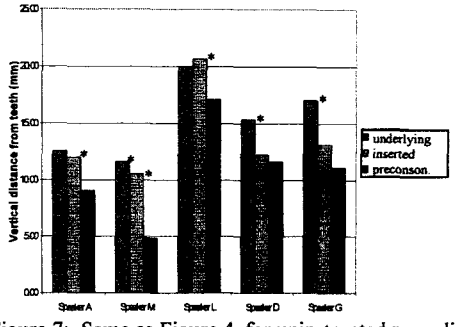


Figure 7: Same as Figure 4, for uninstructed recording.

3.3 Comparison across instructed and uninstructed recordings

We compared 7-9 pairs of words produced spontaneously with schwa insertion and words produced with insertion only under instruction for 4 speakers. (One speaker could not be used because the pellets had to be reattached between recordings.) There were no consistent patterns across speakers, and few significant differences. This confirms that articulation of /l/ is not influenced by whether the speaker inserts schwa spontaneously or under instruction, and that any differences between the results in 3.1. and 3.2. do not stem from differences in articulation during the instructed recording.

4 Conclusions

/l/ before inserted schwa is light, identical to light /l/ before underlying schwa, and different from coda (preconsonantal) /l/. Since /l/ before inserted schwa is light, it must be in syllable onset position, so the schwa must be present as a phonological entity, forming the syllable nucleus. Therefore, the insertion of the schwa must be a phonological process, rather than a phonetic adjustment to articulations. Although it is often quite difficult to show experimentally that a particular alternation is phonological or phonetic, in this case, the fortuitous co-occurrence of schwa insertion and the light/dark /l/ alternation make this possible, and we find evidence that this alternation is part of the grammar of Dutch.

References

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