Syllabification of Intervocalic Consonants in Dutch: Single Consonants or Geminates?

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ABSTRACT

Single intervocalic stops in Dutch are analysed phonologically as geminates when preceded by a short vowel, and as single consonants when preceded by a long vowel. We investigate the phonetic correlates of this phonological distinction. Measurements of consonant durations show no significant difference relative to the preceding vowel, and hence, the underlying phonological distinction between geminates and single consonants appears to be neutralised.

1. INTRODUCTION

Single intervocalic consonants in Dutch are considered to be tautosyllabic with the following vowel or ambisyllabic depending on the nature of the preceding vowel. After a lax vowel the ambisyllabicity condition holds ($VC_1.C_1V$), while a consonant following a tense vowel is syllabified with the following vowel ($V.C_1V$). This analysis is generally accepted in the phonological literature (see Kager's [1] state-of-the-art overview). It is argued that the syllable in Dutch is minimally and maximally bimoraic which means that a long vowel, a diphthong and a sequence of a short vowel plus a consonant are legal syllables. It also follows from this *bimoraic constraint* that an unchecked short vowel cannot be syllable final. In other words, short vowels are restricted to preconsonantal positions in which 'close contact' exists between the vowel and the following consonant. Hence, a single intervocalic consonant after a short vowel is analysed as ambisyllabic (see Figure 1 bottom) while after a long vowel the consonant is syllabified in the following syllable (see Figure 1 top).

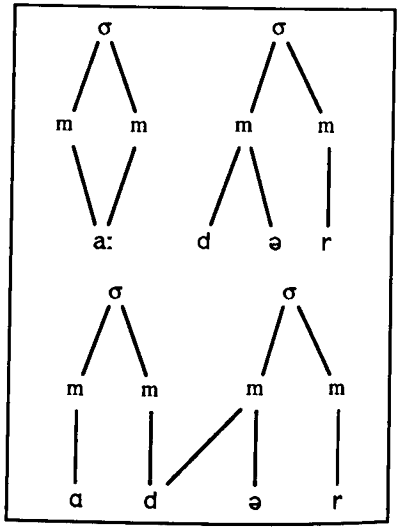

Figure 1. Syllable structure of 'ader' /a:dər/ and 'adder' /ɑdər/ (σ = syllable, m = mora).

There is considerable disagreement

concerning the phonetic correlates of the phonological distinction between geminates (as in /ɑdər/) and single consonants (as in /a:dər/). On the one hand, measurements of consonant duration in Dutch words by Nooteboom [2] reveals that ambisyllabic consonants following a short stressed vowel are significantly longer than tautosyllabic consonants following a stressed long vowel. On the other hand, Jongman & Sereno [3] and Kuijpers [4] found no durational differences of the intervocalic consonants in this environment.

Nooteboom's findings clearly agree with the phonological analysis in the sense that the underlying phonological distinction between geminate and single consonants is reflected at the phonetic level. Failure to detect phonetic differences between those consonants indicates (contextual) neutralisation, i.e., the identical realisation of distinct phonological segments.

In this paper we revisit this controversy. We investigate the duration of intervocalic stops in disyllabic words as a function of the quantity of the preceding vowel.

2. METHOD

A controlled production experiment was carried out in which informants produced 15 minimal disyllabic word pairs. These pairs of existing Dutch lexemes were chose in such a way that all the oral and nasal stops were represented. They contained long - short vowel pairs that have minimal spectral differences in the first syllable. The rhyme of the second syllable consisted of /ə/ followed by /r/ or /l/. Due to difficulties in finding suitable word pairs, 3 pairs ended in a vowel. Words ending in /ən/ were avoided because the final consonant is often deleted.

The subjects, 5 male and 5 female native speakers of Dutch produced each word in a standard carrier sentence. The word was presented on a computer monitor in a large font in a particular colour. 6 different colours were used, and the subject had to insert the word and the colour in which it appeared on the screen in the Dutch equivalent of the sentence 'The colour of ... is ... '. Each subject completed the task three times and during each run, the subjects were presented with a different randomisation of the target word list mixed with 40 distracter words.

Subjects' deliveries were recorded by means of a Sennheiser Microphone MKE 66 and a Sony Digital Audio Taperecorder TCD-D3. Recordings were digitised (Fs = 16.000 Hz, Fc = 8.000 Hz) on a an Apple Quadra 700 by means of a Digidesign Sound Designer II signal processing card and Audiomedia software. Resulting Audiofiles were further processed in Signalize™.

Measurements were made of the duration of the intervocalic stop. In order to establish the duration of a segment, the waveform was used for voiceless stops only. The total duration of the stop was measured as the silence during the occlusion and the release burst.

Measurements of voiced segments were based on a time-aligned wideband (125 Hz) spectrogram.

3. RESULTS

In the first instance, the durations of the intervocalic oral and nasal stops were compared by means of an ANOVA. The results of this analysis are summarised in Figure 2. This analysis turns out to be highly significant ($F(11, 853) = 86.7828$, $p < .0001$). Subsequently, a Student's t-test was carried out between each relevant pair of geminate vs. single consonant, e.g. /b - bb/, /t-tt/ etc. None of these comparisons turns out to be significant.

Next, intervocalic consonant length was compared in terms of place of articulation by means of an ANOVA. This analysis suggests a significant relationship between place of articulation and stop duration ($F(2, 862) = 38.4813$, $p < .0001$). In addition, pairwise comparisons were made between the stop durations for the different places of articulation by means of a Student's t-test. Each of these comparisons turns out to be significant : labial-alveolar ($t = 4.1233$, d.f. = 803, $p < 0.001$), labial-velar ($t = 10.5903$, d.f. = 415, $p < 0.001$), alveolar-velar ($t = 5.8854$, d.f. = 506, $p < 0.001$).

4. DISCUSSION

The aim of this investigation was to investigate whether significant durational differences could be found between underlying geminate and single intervocalic stops. The results presented above clearly indicate that no significant differences exist between stop segments that are regarded distinct in a phonological perspective. These results are in agreement Jongman & Sereno [3] and Kuijpers [4]. This absence of a phonetic difference suggests that we are dealing here with an instance of (contextual) neutralisation.

The results of this investigation indicate that no significant durational differences were found between these two types of segments. However, the analysis of stop durations in terms of their respective place of articulation reveals a striking difference in that velar stops are longer than alveolars, which in turn are longer than labials. The relevance of this finding are discussed in Verhoeven, Gillis & De Schutter [6].

These findings are important from a developmental perspective. Gillis & De Schutter [5] found that children's intuitive syllabifications do not reflect the phonological distinction between geminates (after short vowels) and single consonants (after long vowels). At least there was no trace of that distinction in 5-year-olds' syllabifications. However 8-year-olds do syllabify a word like 'adder' as 'ad.der' in more than 50% of the cases. It was hypothesised that the older children's familiarity with the spelling conventions of the language (esp. the splitting of words: 'adder' is split graphemically as 'ad-der') was instrumental in their intuitive syllabifications. The younger children who are not familiar with the written code have no basis for that syllabification. The present findings strengthen this hypothesis in the sense that the acoustic signal does not support the distinction between geminates and single consonants.

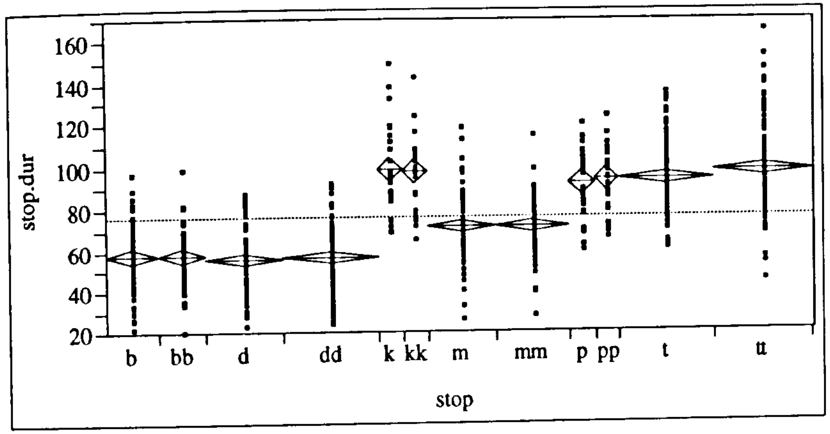

Figure 2. Comparisons of consonant durations for geminate and single consonants.

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REFERENCES

[1] Kager, R. (1989), *A metrical theory of stress and destressing in English and Dutch*. Dordrecht: Foris.

[2] Nooteboom, S. (1972), *Production and perception of vowel duration*. Eindhoven: Philips Research Reports Supplements No. 5.

[3] Jongman, A. & Sereno, J. (1991), "On vowel quantity and post-vocalic consonant duration in Dutch.", *Proceedings of the XIIthe International Congress of Phonetic Sciences*, Vol. 2, pp. 294-297.

[4] Kuijpers, C. (1993), *Temporal coordination in speech development*. Unpublished Dissertation, University of Amsterdam.

[5] Gillis, S. & De Schutter, G. (1995), "Intuitive syllabification: Universals and language specific constraints." Submitted.

[6] Verhoeven, J., Gillis, S. & De Schutter, G. (1995). "Intervocalic geminate and single stops in Dutch syllable structure". Submitted.

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