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A cross-linguistic study of accentual lengthening: Dutch *vs.* English

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Close examination of studies concerned with the distribution of accentual lengthening in Dutch and English reveals that the differences previously found between these two languages may be the result of different experimental designs. Results of new experiments on Dutch using the same conditions as were used in the English experiments indicate that these two languages are indeed more similar than they were previously thought to be; in both languages, all syllables within an accented word are lengthened to some degree, as compared to a baseline unaccented condition, however a greater amount of lengthening is found on an adjacent syllable to the right of the pitch accented syllable than on an adjacent syllable to the left. Furthermore, the data suggest that only the boundaries of syllables and of (syntactic) words influence the distribution of accentual lengthening.

1. Introduction

This paper explores the influence of prosodic structure on accentual lengthening (lengthening related to phrasal prominence) in Dutch and English, two Western-Germanic languages with broadly similar prosodic characteristics. Both of these languages have partially predictable lexical stress based on quantity-sensitive rules (Hayes, 1981), and both have been classified as stress-accent languages (Beckman, 1986; Beckman & Pierrehumbert, 1986). Stress-accent languages are claimed to make greater use of factors other than pitch in signalling prominence than non-stress-accent languages (Beckman, 1986).

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Accentual lengthening has been found to extend over domains larger than the syllable in both Dutch and English (Nooteboom, 1972; Eefting, 1991; Sluijter & van Heuven, 1995, 1996; Turk & Sawusch, 1997; Turk & White, 1999). Despite the fact that Dutch and English have broadly similar prosodic characteristics, accentual lengthening has been claimed to extend throughout different domains in these two languages. Dutch researchers (Nooteboom, 1972; Eefting, 1991; Sluijter & van Heuven, 1995, 1996) claim that phrasal prominence causes a nearly linear time expansion of the entire word in Dutch, whereas Turk & Sawusch (1997) claim that most of the effects of accentual lengthening in English occur within a domain beginning with the onset of the primary stressed syllable, and extending rightward until the end of the word.

In this paper, we reconsider the claim that Dutch and English have different domains of accentual lengthening, in the light of a reexamination of the Dutch literature, and in the light of new English results which show slightly longer initial unstressed syllables in accented words as compared to a completely unaccented baseline condition for some subjects (Turk & White, 1999). We present a critical review of these studies in the following section, and motivate our current study from the fact that the experimental conditions were not always comparable in the two languages. We then present a Dutch accentual lengthening experiment designed to be directly comparable to the Turk & Sawusch English study.

2. Background

In the following sections, we give a review of previous work on the distribution of accentual lengthening effects both across segments within an accented syllable and across syllables within an accented word, in Dutch (Section 2.1) and English (Section 2.2). While the research on Dutch and English agrees that all segments within the accented syllable are lengthened, some discrepant claims have been made with respect to the spreading of accentual lengthening within the accented word. In Section 2.3, we will look into these discrepancies in greater detail.

2.1. *Previous experiments on Dutch*

In this section, we discuss the work on accentual lengthening in Dutch by Nooteboom (1972), Eefting (1991) and Sluijter & van Heuven (1995, 1996). The experimental conditions across these experiments were largely comparable. In general, elements in accented target words were compared with the same elements in unaccented words. The position of accent in sentences where the target word was unaccented was variable across studies, but generally occurred to the right of the target word.

None of the above studies was specifically designed to test the types of constituents which influence the spread of accentual lengthening, nor to directly compare rightward spreading with leftward spreading. Nevertheless, these studies do show that accentual lengthening in Dutch can extend throughout all syllables in an accented word, since all syllables are significantly lengthened when the word is accented. At the surface, therefore, Dutch appears to show results which are inconsistent with the Turk & Sawusch claim for English (i.e., the claim that accentual lengthening extends only to the right of the accented syllable). However, a significant effect in all

syllables does not exclude the possibility of a directional asymmetry, as found for English. We therefore reexamine the Dutch data to determine whether there are any indications of asymmetries in accentual lengthening before and after the pitch accented syllable.

Eefting (1991) provides data on accentual lengthening in Dutch both within the accented syllable and across syllables within the accented word. She investigated the effects of accentuation and focus structure on a single subject's renditions of eight monosyllabic CVC words (e.g., *kaak*) and eight trisyllabic CəCVCəC words (e.g., *gekakel*). The words were embedded in meaningful sentences. Within the monosyllabic CVC words, when accented words representing new information were compared with unaccented words representing old information, Eefting found 41%, 17%, and 40% lengthening on the onset, nucleus, and coda, respectively.[1] When accented words representing new information were compared with unaccented words in a comparable information status condition, she found 61%, 17%, and 41% lengthening on the onset, nucleus, and coda. Vowels thus appear to lengthen less than consonants. Since onsets and codas did not always consist of the same segment, it is difficult to compare their magnitudes of lengthening.

In Nooteboom (1972), the effect of accent was studied on two subjects' renditions of reiterant nonsense words such as /'paːpaːpaːp/, /paː'paːpaːp/, /paːpaː'paːp/, etc., which varied in number of syllables (2, 3, or 4), position of lexical stress, and segmental composition. The target nonsense words were placed in the frame sentence *De uiting […] is onzin* ("the utterance […] is nonsense"), where the pitch accent occurred either on the target word (accented condition), or on the first syllable of *onzin* (unaccented condition). Results showed that all syllable nuclei in accented words may be lengthened under accent, but that magnitudes of lengthening vary considerably across speakers, syllable position, stress position, and number of syllables. Nooteboom formulates and perceptually verifies several rules determining vowel durations, incorporating the effects of stress, position in the word and number of syllables following in the word. Crucially though, he states that "[t]he same rules essentially apply in dominant and non-dominant words" (Nooteboom, 1972, p. 75), where "dominant" corresponds to "accented" in our terminology. So, no consistent interactions or asymmetries were observed with respect to durational effects of accent.

Eefting (1991) and Sluijter & van Heuven (1995, 1996) also found that all syllables in accented words are longer than comparable syllables in unaccented words. As mentioned earlier, Eefting (1991) investigated the effects of accent and focus independently. She found that all segments and syllables contribute to the change in word duration due to accent. The extent to which each syllable participates in the lengthening, however, seems to depend at least partly on its position in the word (or its position relative to the accent). The syllable durations for Eefting's trisyllabic target words are given in Table I, giving results for [+ accent] *vs.* [− accent] (both conveying new information) and for [+ accent/new] *vs.* [− accent/old] (combining information status and accent condition, as is usually done in the literature).

[1]These percentages as well as the other percentages reported in this paper, were calculated using the formula ((DURacc − DURunacc)/DURunacc) × 100. The percentages reported in Eefting (1991) differ from the ones given here because another formula was used, expressing the durational difference between + / − accent relative to the *accented* duration: ((DURacc − DURunacc)/DURacc) × 100.

TABLE I. Summary of syllable durations (in ms) in previous Dutch work. Grey shading indicates lengthening of unstressed syllables

Eefting (1991)	[+accent] *vs.* [−accent] (both new)				[+accent/new] *vs.* [−accent/old]			
	(ge	'ka	kel)		(ge	'ka	kel)	
− accent	81	199	96		90	199	103	
+ accent	110	285	124		102	23	128	
% length	35.8%	43.2%	29.2%		13.3%	37.2%	24.3%	
Sluijter & van Heuven (1995)	+ accent: focus on word				+accent: focus on stressed syl			
	(por	'tiek)	('pot	lood)	(por	'tiek)	('pot	lood)
− accent	190	201	246	148.5	190	201	246	148.5
+ accent	215	252.5	300	193	212	260	299	192.5
% length	13.2%	25.6%	22.0%	30.0%	11.6%	29.4%	21.5%	29.6%
Sluijter & van Heuven (1996)	Lexical				Reiterant			
	(ka	'non)	('ka	non)	(na	'na)	('na	na)
− accent	142	262	227	214	157	260	235	190
+ accent	151	278	254	233	162	289	261	209
% length	6.3%	6.1%	11.9%	8.9%	3.2%	11.2%	11.1%	10.0%

In the latter conditions, unstressed syllables to the left of the accented syllable are lengthened less than unstressed syllables to the right of the accented syllable (13% *vs.* 24%). When both conditions convey new information, however, the opposite seems to be the case (36 *vs.* 29%). Therefore, rightward spreading seems stronger than leftward spreading only when accent condition is combined with information status. At this point, we do not know why this spreading should be any different when the accent conditions have the same information status.

In Sluijter & van Heuven (1995), five words with initial stress (like *'potlood*) and six words with final stress (like *por'tiek*) were placed in the frame sentence *Ik heb […] gezegd* ("I have […] said"), with a precursor question putting focus on the whole test word (broad focus), on the accented syllable only (narrow focus), or on the word *gezegd* (no focus, unaccented). In Sluijter & van Heuven (1996), the words *'kanon* and *ka'non* and reiterant versions (*'nana*, *na'na*) were placed in the frame sentence *Wil je […] zeggen* ("Will you […] say"). In unaccented condition, the word *zeggen* was accented. Their results are also summarized in Table I. Both Sluijter & van Heuven (1995) and Sluijter & van Heuven (1996) show indications of asymmetric accentual lengthening within a word: final unstressed syllables consistently show greater magnitudes of accentual lengthening than initial unstressed syllables.

In summary, there is at least some indication that unstressed syllables to the left of a pitch accented syllable may be lengthened less than unstressed syllables to the right of a pitch accented syllable in Dutch. However, since the segmental composition of these syllables was not the same, it is difficult to make firm conclusions without additional data.

2.2. *Previous experiments on English*

In this section, we discuss previous accentual lengthening experiments on English by Turk & Sawusch (1997), Sluijter (1995) and Turk & White (1999). We will pay particular attention to methodological differences between the study by Turk & Sawusch and the ones on Dutch described above, since the Turk & Sawusch conclusion regarding the domain of accentual lengthening in English is different from the one drawn for Dutch.

In Turk & Sawusch (1997), four conditions surrounding unstressed syllables were constructed such that the leftward and rightward spreading of accentual lengthening both within the word and across a word boundary could be investigated. They used material in which a syllable could belong either to the first or the second word, so that the segmental content of the test syllable was the same in all conditions. From here on, and as in Turk & Sawusch (1997) and Turk & White (1999), in the notation of the environments in which the test items occurred an underscore "_" denotes the relative position of the test item (e.g., A_#u); other symbols include # (= word boundary), A (= accented syllable) and u (= unaccented syllable).

To investigate accentual lengthening within the accented syllable, Turk & Sawusch started off with a study of intervocalic consonants (underlined in the following examples) in sequences of two monosyllables in two different accent environments: Accented vowel_Unaccented vowel (e.g. *BEE farm*/*BEEF arm*), and Unaccented vowel_Accented vowel (e.g., *bee FARM*/*beef ARM*; the accented syllable is in capitals). Results showed that consonants were always longer when the word they belonged to was accented, and that initial consonants were influenced somewhat more than final consonants. These English results are compatible with Eefting's results for Dutch. In the second experiment, durations of unaccented syllables in disyllabic words were measured to determine whether accentual lengthening could extend beyond a syllable boundary. The same accent and word position environments were used: the test syllables (underlined) thus occurred in phrases such as *BACon force* (A_#u), *BAKE enforce* (A#_u), *bacon FORCE* (u_#A) and *bake enFORCE* (u#_A). The conditions in which the test syllable is separated from the accent by a word boundary are considered to be the unaccented environments. The results of this experiment are shown in Fig. 1.

The results show that the spreading of accentual lengthening in English is asymmetric: the effect of u_A *vs.* A_u on final syllables was relatively large (19 ms, 12%), whereas there was no apparent effect of accent on initial syllables. The lack of an effect of accent on initial syllables seemed at odds with the Dutch results which had shown significant amounts of lengthening on initial and final syllables, as duly noted by Turk & Sawusch. In fact, they discuss an alternative account for their data in which there is both a leftward effect within the word as well as a rightward effect crossing a word boundary, yielding some lengthening both in *bake enFORCE* (leftward within the word) and in *BAKE enforce* (rightward across a word boundary), i.e., in the conditions in which the test syllable is word-initial.[2] This interpretation of the Turk & Sawusch results predicts that some lengthening (a *baseline effect*) would be found for word-initial syllables if they were compared with unstressed syllables without any accent in the immediate vicinity (referred to here as the *baseline condition*). However, on the grounds of indirect evidence from the consonantal experiment just discussed, Turk & Sawusch argue that there is no

[2]Note that this alternative account does not dispute the conclusion that the lengthening is asymmetric in English.

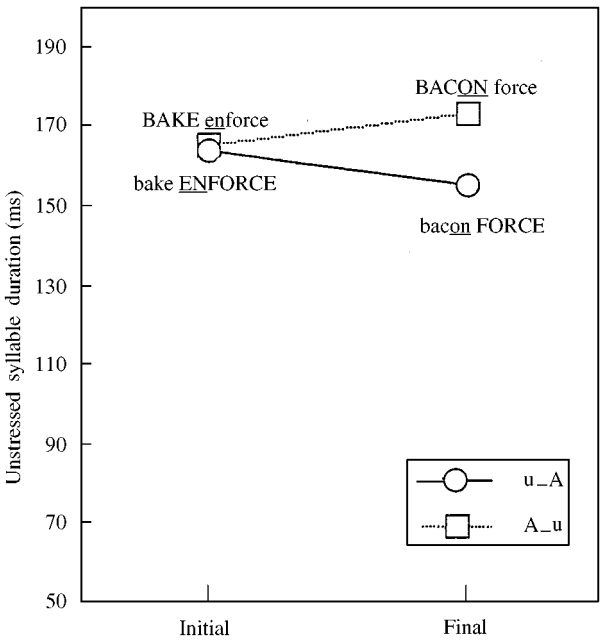

Figure 1. Taken from Turk & Sawusch (1997; Figure 5). The interaction between Position and Accent effects on unstressed syllable duration, averaged across all word types. The "bake enforce/bacon force" text exemplifies the type of word sequence occurring in each environment.

rightward effect crossing a word boundary, and thus no leftward effect within the word either (since the test syllable in *bake enFORCE* is just as long as in *BAKE enforce*). They therefore conclude that besides the accented syllable only syllables following the accent within the word are lengthened. Under this analysis, the unaccented conditions (those in which the test syllable is outside of the accented word) can be considered baseline conditions (since in neither of these conditions does the accent have any effect), and word-initial syllables are not lengthened. The fact that *initial* non-lengthened syllables (in *BAKE enforce* and in *bake enFORCE*) were slightly longer than *final* non-lengthened syllables (in *bacon FORCE*) could possibly have been explained by the fact that initial syllables shared word membership with different phonetic material than final syllables did: in *bake enforce*, *en-* shares word membership with *-force*, while in *bacon force*, *-on* shares the word along with *bac-*.

Other experiments on accentual lengthening in English, following those reported in Turk & Sawusch (1997), seem to indicate that word-initial syllables *do* show a baseline effect (i.e., a difference between the accented condition and a condition with no accent in the vicinity of the test syllable), implying that the alternative account in the Turk & Sawusch results in which there is both a leftward effect within the word and a rightward effect crossing a word boundary can account for more data. Sluijter (1995) conducted an English experiment using the same experimental conditions as the Dutch *'kanon-ka'non* study, with four sets of real words (e.g., *'compact-com'pact*) and their reiterant imitations. The frame sentence was *Please produce […] for him again*, with focus (hence accent) on the target word or on *again*. The results are summarized in Table II.

TABLE II. Summary of syllable durations (in ms) in previous English work by Sluijter (1995). Grey shading indicates lengthening of unstressed syllables

Sluijter (1995)	Lexical				Reiterant			
	(com	'pact)	('com	pact)	(ba	'ba)	('ba	ba)
− accent	147	272	184	236	159	198	189	157
+ accent	160	319	220	274	171	238	230	190
% length	8.8%	17.3%	19.6%	16.1%	7.5%	20.2%	21.7%	21.0%

These results show that there is a baseline effect for word-initial unstressed syllables (of around 8%), although the effect on word-final unstressed syllables is greater in magnitude (16–21%).

Turk & White (1999) conducted several experiments with speakers of Scottish English which replicated and extended the Turk & Sawusch experiments. They added a baseline condition with no accent in the vicinity of the test syllable and found a picture which is also more consistent with a baseline effect to the left of the accent within the word. The accentual lengthening effect on initial unstressed syllables was relatively small (4–5%), and significant in a by Items analysis, but not in a by Subjects analysis; this suggests that there may be some intersubject variability with respect to the effect on initial unstressed syllables in English. The Turk & White (1999) results agree with those of Turk & Sawusch (1997) in that the rightward effect within the word is clearly stronger than the leftward effect, showing that the distribution of accentual lengthening is asymmetric in English.

2.3. *Differences and similarities between the Dutch and English experiments*

All the Dutch experiments found that every syllable within a word is lengthened when the word is accented. Even though the extent to which each syllable was lengthened varied, the general conclusion has been that an accent causes linear expansion of the entire word. This conclusion is in sharp contrast to the Turk & Sawusch conclusion for English. They claim that accentual lengthening starts with the accented syllable and spreads only to the right to include following unstressed syllables within the word. However, the conclusions for both Dutch and English may not be entirely accurate.

A closer look at the Dutch data revealed that in this language too, accentual lengthening is regularly found to spread more to the right than to the left, as in English. So, even though both word-initial and word-final syllables are indeed lengthened, there may still be an asymmetry with respect to the amount of accentual lengthening on these syllables which is in the same direction as the asymmetry observed for English.

New experiments on English by Turk & White (1999), following those reported in Turk & Sawusch (1997), indicate that unstressed syllables to the left of the accent may also be lengthened relative to a baseline condition without any accent in the immediate environment, although not as much as syllables to the right. These observations are in agreement with the findings in Sluijter (1995). There is thus some evidence that English has a leftward baseline effect too, though not nearly as large as the rightward baseline effect.

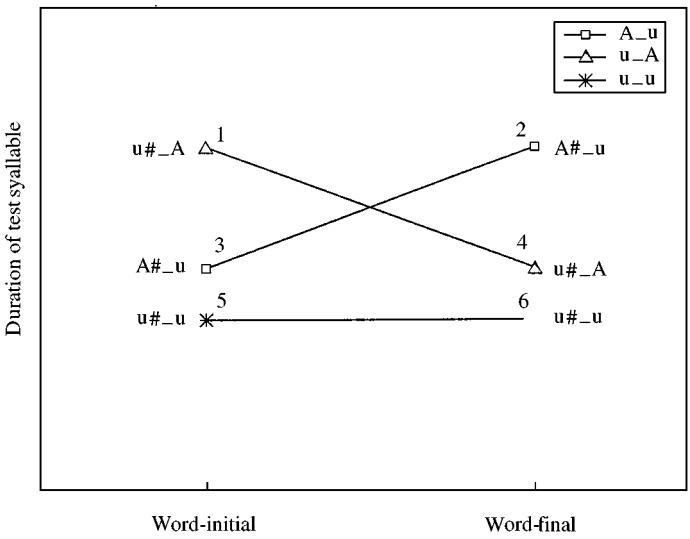

Diagram 1. Schematic representation of hypothetical results using six conditions. The numbers in the figure are for ease of reference in the text.

The conclusion drawn by Turk & Sawusch that Dutch and English have different domains of accentual lengthening may find its origin in the different conditions which were used. These differences may be best illustrated with the help of Diagram 1. In this diagram, the hypothetical results for six different conditions are depicted, assuming for the moment that (1) there is a symmetric lengthening effect within an accented word, i.e., accentual lengthening within the word spreads equally to the right and to the left (so that $(1 - 5) = (2 - 6)$), and (2) there is a smaller effect crossing a word boundary, i.e., a word boundary has an attenuating effect on the spreading of accentual lengthening, but does not block the effect entirely (so that $(3 - 5) < (1 - 5)$ and $(4 - 6) < (2 - 6)$).[3]

In Turk & Sawusch (1997), conditions 1–4 were used. The Dutch studies, however, used conditions 1, 2, 5 and 6 (except for one of Sluijter's experiments, in which word-final syllables outside the accented word occurred in condition 4 instead of 6). This means that the unaccented conditions with which syllables in accented words were compared were not the same.

The English Turk & Sawusch experiments indicate that the first preliminary assumption (symmetric lengthening within the word) does not hold for English, since accentual lengthening was found to spread only to the right. Although word boundaries clearly show an attenuating effect on the spreading of accentual lengthening, little can be said about the amount of lengthening crossing a word boundary, since the baseline conditions 5 and 6 were not included. The two possible accounts in the Turk & Sawusch results discussed above are actually two hypotheses concerning the relationship between conditions 3 and 4 included in the experiment and the non-included baseline conditions

[3]Although we have just argued that Dutch may also show asymmetric lengthening (like English), at this point we take symmetric lengthening as the null hypothesis for Diagram 1, following the claims made for Dutch in the literature. The assumption that there is a smaller effect crossing a word boundary is based on findings in Turk & White (1999).

5 and 6; the Turk & Sawusch analysis presumes that there is no difference between these unaccented conditions, but at that point there was no direct evidence for this or any alternative view.

Turk & White (1999), while replicating the experiments by Turk & Sawusch on American English for Scottish English, also added conditions 5 and 6. Again the effect was found to be asymmetrical for English. Moreover, the word-initial syllables in conditions 1 and 3 were both longer than in the baseline condition 5 (by 4–5%), indicating that there can be both a small effect to the left within the word (u#_A, condition 1) and a small rightward effect crossing a word boundary (A#_u, condition 3). Unstressed syllables within the word and following the accent (A_#u, condition 2) were clearly lengthened most, while no baseline effect was found for syllables to the left of the accent outside the word (condition 4 = condition 6).

The effect of the different conditions used in the Dutch and English experiments on the outcome of these experiments may now be understood as follows. From the more recent experiments by Turk & White, we may conclude that at least in English conditions 1 and 3 yield test syllable durations which do not differ from each other, but which are both longer than the test syllable in the baseline condition (5). Turk & Sawusch had no baseline condition, and thus found no effect in word-initial syllables, since they compared condition 1 with condition 3. The Dutch studies, on the other hand, found an effect on word-initial syllables because they were comparing condition 1 with condition 5; these results seem contradictory, yet both are in accordance with the picture emerging from Turk & White. Therefore, we cannot conclude that Dutch and English are different with respect to the spreading of accentual lengthening without further experiments.

In order to make a valid comparison between Dutch and English accentual lengthening, the data on Dutch need to be complemented. In fact, as noted above, none of the Dutch studies was explicitly designed to study the effects on unstressed syllables, while these are presently our main interest. Consequently, the conditions for the unstressed syllables were not always comparable; first, the distance between the unstressed syllable and the nearest accent was not controlled; second, the unstressed syllables to the left and right of an accent were segmentally different; third, unstressed syllables to the left of the accented syllable were always word-initial, and unstressed syllables to the right of the accented syllable were always word-final: possible effects of position in the word could therefore confound directional effects. Also the effect of a word boundary on the spreading of accentual lengthening has as yet remained untested in Dutch.

To resolve these omissions, we ran new experiments for Dutch with experimental conditions comparable to those used by Turk & Sawusch (conditions 1–4). Unstressed syllables with the same segmental content were thus placed in four environments which allowed us to investigate the effect of a word boundary and directional effects more precisely. Moreover, by including test units of several types, we also attempted to determine which type of (prosodic) boundaries influence the spreading of accentual lengthening. More specifically, we investigated the effects of the boundary between onset/vowel and vowel/coda; between two syllables, two stems and two content words and finally, between a content word and a function word. The goals of the present experiments on Dutch are thus three-fold:

1. To afford a valid comparison between Dutch and English accentual lengthening, i.e., based on identical experimental conditions.

2. To complete the picture on accentual lengthening in Dutch by investigating possible directional effects and the effect of a word boundary on the spreading of accentual lengthening.
3. To find out which type of (prosodic) boundaries influence the spreading of accentual lengthening in Dutch.

3. Dutch replication of Turk & Sawusch experiments

3.1. *Introduction*

The present experiments were conducted to fill the gaps in our knowledge of the domain of accentual lengthening in Dutch as compared to English. Several test units were included in the experiment (the segment, the syllable, the stem and the function word). These test units were always placed between two primary lexically stressed units. Only one of these stressed units was accented in each condition; thus, the test unit was either followed or preceded by a pitch accent (e.g., *PANda masten vs. panda MASten.* The test syllable is underlined and the accented syllable is in capitals). The distance between the test unit and the accent was comparable across all conditions, since the test unit was always adjacent to an accented unit. Where applicable (not for the function word as test unit), the place of the word boundary was ambiguous; if it followed the test unit, the test unit formed a word with the first stressed unit, and was thus word-final (e.g., *panda # masten*); if it preceded the test unit, the test unit formed a word with the second stressed unit, and was thus word-initial (e.g., *pan # damasten*). Due to this requirement of an ambiguous word boundary position, many of the test phrases do not form meaningful word combinations. In all, there were four test unit conditions (but only two for function words).

As in Turk & Sawusch (1997), the first test unit included in the experiment was the segment (or consonant). The results for this unit were predictable, since Eefting (1991) already found that both onset and coda consonants are lengthened when they belong to an accented syllable. This test unit can therefore serve as a first check to see whether the present methodology extracts the results we expected on the basis of other studies.

The second test unit was the syllable. As may be clear from the preceding discussions, the behavior of the test syllable in this experiment is of vital importance to the issues raised in this paper. If it behaves as is predicted by the claims in the literature about Dutch, both test syllables preceding and following the accent will be lengthened; however, if it behaves the same as in English, only the test syllable *following* the accent should be lengthened. Furthermore, the influence of a word boundary on the spreading of accentual lengthening can also be tested, since the test syllable either belonged to the same word as the accented syllable or was separated from it by a word boundary.

The third test unit was the stem. This unit was included to find out whether morphological compounds behave differently from non-compounds, as was also done in Turk & White (1999). In Dutch, each stem forms a separate prosodic word (Nespor & Vogel, 1986). So, if the domain of accentual lengthening is the prosodic word, the test stem should behave similarly in cases like *reisdoel matig* and *reis doelmatig*, since *doel* in both cases is a separate prosodic word and would thus be outside of the domain of accentual lengthening. However, if lengthening on the test stem in cases like *REISdoel*

matig is much greater than in *REIS doelmatig*, we would have evidence that the domain of accentual lengthening is larger than the prosodic word, since it exceeds the accented stem.

To investigate the domain of accentual lengthening further, a fourth test unit was included, which was the function word. Booij (1995) claims that most function words in Dutch may cliticize prosodically to the left or to the right, depending on their phonetic shape and the surrounding context, but they do not always need to do so. The place of clitics and function words in the prosodic hierarchy is still at issue (e.g., Selkirk, 1995), perhaps especially in languages such as Dutch and English where function words are not syntactic clitics but show only phonological dependency (Booij, 1995). In any case, if for example a function word and a preceding content word form part of the same accentual lengthening domain, then we would expect a much greater amount of accentual lengthening on the function word when it is preceded by an accent.

3.2. *Test material*

Several types of test units were included in the test material. We give examples of each of these test units below. The examples show only the two word boundary positions; all items also occurred with a pitch accent either on the first or on the second stressed syllable.

The first test unit was the segment. Some examples are given in (1), in which the test segments are underlined (the complete set of data can be found in Appendix A):

segment	diep in "deep in"	/'dip 'ɪn/	—	die pin "that pin"	/'di'pɪn/	(1)
	rijp oker "ripe ochre"	/'rɛip 'oːkər/	—	rij poker 'line poker'	/'rɛi 'poːkər/	

Two such pairs, adapted from Quené (1989), were made for each of the consonants /f/, /χ/, /m/, /p/ and /t/, resulting in 10 pairs.

The second test unit was the syllable. Care was taken only to include sets which form monomorphemic words, in order to clearly distinguish this set from the third test unit, which was the stem (forming polymorphemic words). Again, 10 sets were composed for each type, and are listed in Appendix A. Some examples are given below:

syllable	panda masten /'pɑndaː 'mɑstən/ "panda masts"	—	pan damasten /'pɑn daː'mɑstən/ "pan damask"		(2)
	torso sjalen /'tɔrsoː 'ʃaːlən/ "torso scarfs"	—	tor socialen /'tɔr soː'ʃaːlən/ "beetle socials"		
stem	reisdoel matig /'rɛisdul 'maːtəx/ "destination moderate"	—	reis doelmatig /'rɛis dul'maːtəɤ/ "travel efficiently"		(3)
	zinvol brengen /'zɪnvɔl 'brɛŋən/ "useful bring"	—	zin volbrengen /'zɪn vɔl'brɛŋən/ "sentence fulfil"		

Finally, a fourth test unit (the function word) was placed between two content words. Four different function words were included, two of which are articles (thus syntactically closely affiliated with the noun on the right), and two of which are object pronouns (thus syntactically more closely affiliated with the verb on the left). Five sets were made for

TABLE III. Examples of measured units for each type of test unit

Test unit	(Onset)	1st lexically stressed unit	Test unit	2nd lexically stressed unit	(Rest of test phrase)
Segment	d	ie	p	i	n
Syllable		pan	da	mas	ten
Stem		reis	doel	ma	tig
Function word		gooi	de	tak	

each function word. Some examples are shown below:

function word	verf de deur /'vɛrf də 'døːr/	bak ze bruin /'bɑk sə 'brœyn/	(4)
	"paint the door"	"bake them brown"	
	gooi de tak /'xoi də 'tɑk/	zet ze terug /'zɛt sə 'trʏx/	
	"throw the branch"	"put them back"	
	koop een krant /'koːp ən 'krɑnt/	maak hem klein /'maːk əm 'klɛin/	
	"buy a paper"	"make it small"	
	kies een kleur /'kis ən 'kløːr/	schrijf hem gauw /'srɛif əm 'xɑu/	
	"pick a color"	"write him soon"	

The total material thus consisted of (10 items × 2 word boundary positions × 2 accent conditions =) 40 utterances for the segment, syllable and stem test units, and (4 function words × 5 items × 2 accent conditions =) 40 utterances for the function word unit as well.[4]

Besides the test units, the duration of the corresponding units to the left and right of the test units were also measured (thus, for the segment unit, the duration of the *vowels* neighboring the test consonant was measured, and in the other cases the *syllables* (or monosyllabic words) surrounding the test unit were measured). These units were all lexically stressed. In Table III, examples of what is meant by each of the terms "first lexically stressed unit", "test unit", and "second lexically stressed unit" are given for each type of test unit.

3.3. *Frame sentence*

Initially, the frame sentence was translated literally from the English experiments (*I said […], not […]*), giving *Ik zei […], niet […]*. Results from four subjects, however, revealed that this frame sentence did not elicit a constant amount of accentual lengthening on the stressed units: much to our surprise, we found a large difference in the amount of accentual lengthening between the first stressed unit (e.g., *pan* in *pan-da-masten*) and the second (e.g., *mas* in *pan-da-masten*). Averaging over test units, the second stressed unit was only lengthened by 6%, which is not even a fourth of the 25% with which the first stressed unit was lengthened.

[4]Some additional material was also recorded, including some meaningful fillers, but these results are not reported on. In short, though, we can say that the results for the meaningful fillers were always highly similar to those for the test material, suggesting that the nonsense test phrases were produced as if they were meaningful phrases.

This difference in the amount of accentual lengthening between accent conditions posed a potential problem for the present investigation. With these results, if we were to find a difference between leftward and rightward lengthening in Dutch, we would not know whether this is caused by a general asymmetry between leftward and rightward lengthening or by a difference in the amount of accentual lengthening in these conditions. Noticeably, this problem was not encountered in English; Turk & Sawusch (1997) had 19% lengthening on the first syllable and 25% on the second syllable, and Turk & White (1999) found 20% lengthening on the first syllable and 24% on the second.

To avoid this problem, and acting on the supposition that the lack of accentual lengthening was due to an interaction with final lengthening (in the sense that the latter hinders the former, cf. Cambier-Langeveld, 2000), we changed the frame sentence such that the test material was no longer in phrase-final position. The change in frame sentence was minimal (only using a past participle instead of a past tense). Examples of complete sets of frame sentences for two test items are given below:

(5)

Ik heb "DIEP in" gezegd, niet "DAL in".
Ik heb "DIE pin" gezegd, niet "DE pin".
Ik heb "diep IN" gezegd, niet "diep UIT".
Ik heb "die PIN" gezegd, niet "die PEN".

Ik heb "PANda masten" gezegd, niet "HINde masten".
Ik heb "PAN damasten" gezegd, niet "VAN damasten".
Ik heb "panda MASten" gezegd, niet "panda POORten".
Ik heb "pan daMASten" gezegd, niet "pan kaDASter".

In the data obtained with the revised frame sentence, the first stressed unit (e.g., *DIEP*/*DI*E and *PAN* in (5)) was lengthened by 22% and the second stressed unit (e.g., *PIN*/*IN* and *MAS* in (5)) by 11%. Even though the amount of accentual lengthening on the first stressed unit is still larger than that on the second stressed unit, the lengthening on the second stressed unit was now significant for all test units, while with the initial frame sentence the lengthening on the second stressed unit was significant only for the function word unit.[5] Placing the test material in non-phrase-final position thus helped considerably to increase the amount of accentual lengthening on the second stressed unit. We will assume that the results for the test units are now comparable across conditions,

[5]Analyses of variance with the duration of the second stressed unit as the dependent variable, Accent condition as the fixed factor and random factors of Items or Items-Within-Function-word (for the test function word) and Subjects, for each type of test unit separately, give the following results:
With initial frame sentence (results for test units *not* presented in this paper):
Test segment, by Items: $F(1,9) = 2.08$, n.s., by Subjects: $F(1,3) = 2.08$, n.s.
Test syllable, by Items: $F(1,9) = 2.53$, n.s., by Subjects: $F(1,3) = 4.94$, n.s.
Test stem, by Items: $F(1,9) = 16.59$, $p < 0.01$, by Subjects: $F(1,3) = 3.78$, n.s.
Test function word, by Items-Within-Function-word: $F(1,16) = 281.69$, $p < 0.01$, by Subjects: $F(1,3) = 85.82$, $p < 0.01$.
With revised frame sentence (results for test units *are* presented in this paper):
Test segment, by Items: $F(1,9) = 22.65$, $p < 0.01$, by Subjects: $F(1,7) = 147.90$, $p < 0.01$.
Test syllable, by Items: $F(1,9) = 76.63$, $p < 0.01$, by Subjects: $F(1,7) = 78.83$, $p < 0.01$.
Test stem, by Items: $F(1,9) = 444.97$, $p < 0.01$, by Subjects: $F(1,7) = 51.20$, $p < 0.01$.
Test function word, by Items-Within-Function-word: $F(1,16) = 158.47$, $p < 0.01$, by Subjects: $F(1,7) = 118.29$, $p < 0.01$.

since they are immediately next to a significantly lengthened accented syllable in all cases, but we will come back to this issue in Section 4.1. In Section 3.4 and 3.5, we describe the method and results for the experiment with the revised frame sentence only.

3.4. *Method*

3.4.1. *Subjects*

Eleven native speakers of Dutch without any reported speech or hearing impairments, or any obvious regional accents, participated in the experiment. Three of them were excluded because they had clearly audible variations in intonation patterns or tempo. The other eight subjects produced all utterances with the same intonation contour, with a "default" pointed hat on the accented syllable, at a constant speech rate, and their realizations of the nonsense phrases sounded quite natural. Their recordings were used for analysis. Four of these subjects were male, the other four, female.

3.4.2. *Procedure*

The stimuli were organized into groups having approximately the same type of test phrase, that is, the stem and syllable items were combined into one group since they consisted of a sequence of four syllables (in which the second syllable is the test syllable or stem, e.g., *pan damasten*), while the function word items and the segment items were kept in separate groups, since they consisted of three monosyllabic words (e.g., *gooi de tak*) *vs.* a monosyllabic word followed by a mono- or disyllabic word (e.g., *diep in*, *rijp oker*). This was done to make the reading task easier for the subjects. Each group consisted of four blocks according to the word boundary position and accent position. The items were randomized in each block. All blocks with accent on the first stressed unit were placed in one part (A) of the recording sessions. The other part (B) consisted of the same items, but with the pitch accent on the second stressed unit. Each part contained 80 test items + 20 fillers = 100 utterances. The order in which the items were presented in each part (1-100 or 100-1), and the ordering of parts (A-B or B-A), were counterbalanced across subjects.

The material was printed out on paper. In the frame sentences, the intended word boundaries were signalled by spaces and the word to be accented was printed in capitals. The word to be accented was also contrasted with another word of the same composition (in terms of number of syllables and stress pattern) elsewhere in the sentence (see (5)).

Subjects were seated in a sound-insulated booth and instructed to read out the material at a normal speech rate, without any pauses within the test material. The first author listened to their speech at the same time and would interrupt the subject if an utterance seemed disfluent and another repetition was required. Their speech was recorded onto DAT-tape through a Sennheiser MKH-416 directional condenser microphone. The utterances were then copied onto a computer disk and down-sampled to 16 KHz.

3.4.3. *Measurements*

The material was segmented by hand according to the guidelines for Dutch given in van Zanten et al. (1991). In some cases (e.g., for the test item *rijp oker*), some speakers realized a glottal stop at the word boundary. If this was done consistently across accent conditions (in *RIJP oker* and in *rijp OKER*), segment boundaries were drawn such that the glottal stops were not included in the duration of the test unit. Otherwise, all four

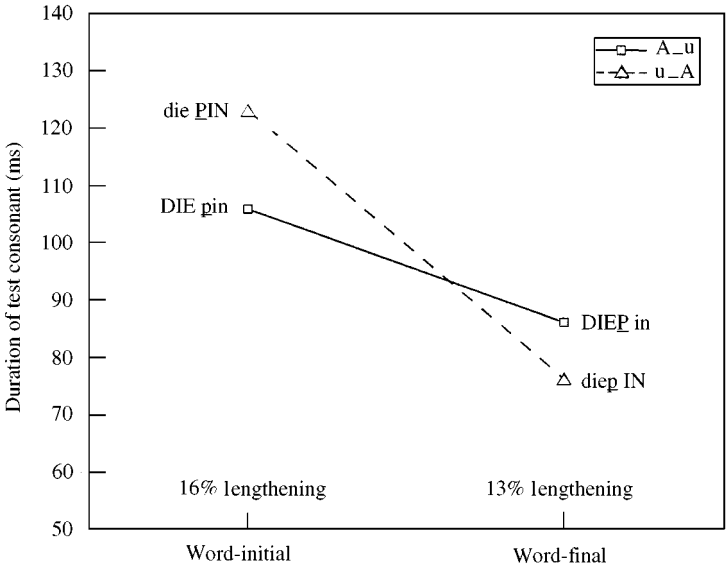

Figure 2. Results for the test consonants. The interaction between Position and Accent effects, averaged across items. The texts in the figure exemplify the type of word sequence occurring in each environment.

realizations (2 word boundary positions × 2 accent conditions) of that item by that speaker were excluded from the data. The same number of measurements were thus included for all conditions within a test unit. Similarly, all realizations of a certain item and speaker were excluded if one of them did not sound like a correct manifestation of the desired accentual or word structure. Consequently, the results are based on 288 measurements for the test segments (10% excluded), 280 measurements for the test syllables and stems (12.5% excluded), and 304 measurements for the test function words (5% excluded).

3.5. *Results*

3.5.1. *Duration of test segments*

In order to determine whether Position and Accent condition had an effect on the duration of consonants within and outside the accented word, an ANOVA was run with duration of the test consonant as the dependent variable, fixed factors of Accent (A_u *vs.* u_A) and Position (word-initial *vs.* word-final), and random factors of Items (e.g., *diep in/die pin vs. rijp oker/rij poker*) and Subjects. These analyses showed a main effect of Position (by Items: $F(1,9) = 32.70$; $p < 0.01$, by Subjects: $F(1,7) = 47.74$; $p < 0.01$), but not of Accent (by Items: $F(1,9) = 3.93$; $p = 0.08$, by Subjects: $F(1,7) = 2.58$; n.s.). There was also a significant interaction between Position and Accent (by Items: $F(1,9) = 116.28$; $p < 0.01$; by Subjects: $F(1,7) = 43.01$; $p < 0.01$).

In Fig. 2, the durations of the test consonants are given for each word position and accent condition. The lengthening of onset consonants can be seen on the left, where /p/ in *die PIN* is longer than in *DIE pin*, while the lengthening of coda consonants is depicted

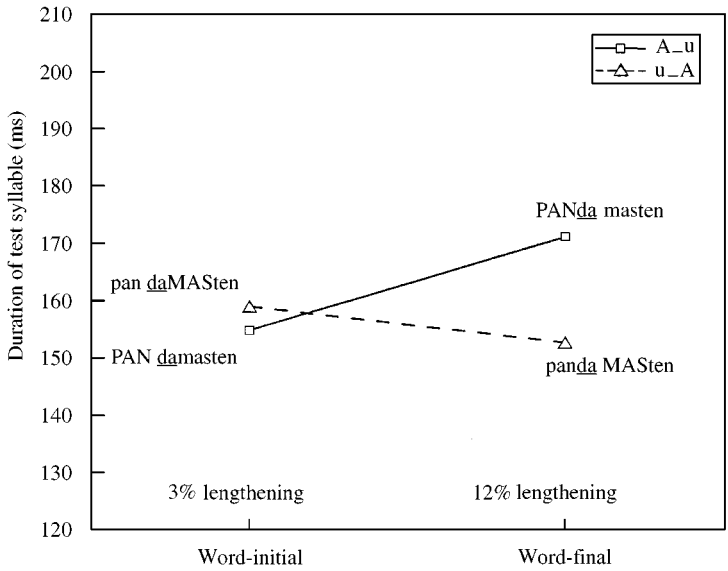

Figure 3. Results for the test syllables. As Fig. 2.

on the right, where /p/ is longer in *DIEP in* than in *diep IN*. Planned comparisons (Fixed factor: Accent, Random factors: Items and Subjects) for each Position show that the effect of Accent is significant for both onset consonants (by Items: $F(1,9) = 39.51$; $p < 0.01$, by Subjects: $F(1,7) = 19.56$, $p < 0.01$) and coda consonants (by Items: $F(1,9) = 26.92$; $p < 0.01$, by Subjects: $F(1,7) = 45.33$, $p < 0.01$). In all, these results are as we expected them to be, on the basis of Turk & Sawusch's results as well as of Eefting's work on accentual lengthening within the syllable: both onset consonants and coda consonants are lengthened when they are within an accented syllable.

3.5.2. *Duration of test syllables*

An ANOVA with duration of the test syllable as the dependent variable, fixed factors of Accent and Position and random factors of Items and Subjects showed a main effect of Accent (by Items: $F(1,9) = 13.88$; $p < 0.01$, by Subjects: $F(1,7) = 15.40$; $p < 0.01$) and a significant interaction between Accent and Position (by Items: $F(1,9) = 93.27$; $p < 0.01$, by Subjects: $F(1,7) = 24.51$; $p < 0.01$), and no main effect of Position (by Items: $F(1,9) = 2.94$, n.s., by Subjects: $F(1,7) = 4.14$, $p = 0.08$). The interaction between Position and Accent is shown in Fig. 3. The effect on word-final syllables (on the right) is clear; these syllables are lengthened by 12% when the word they belong to is accented. The effect on the word-initial syllables (on the left), however, is very small (3%). Planned comparisons for each Position (Fixed factor: Accent, Random factors: Items and Subjects) show that Accent has a significant effect on the duration of the word-final syllables (by Items: $F(1,9) = 52.03$; $p < 0.01$, by Subjects: $F(1,7) = 33.15$, $p < 0.01$), while the effect on word-initial syllables is significant at a 0.05 level in the by-Items analysis only (by Items: $F(1,9) = 5.12$, $p < 0.05$, by Subjects: $F(1,7) = 2.60$, n.s.).

The attenuating effect of a word boundary is clear from the fact that a syllable outside the accented word does not show the same lengthening as a syllable within the accented

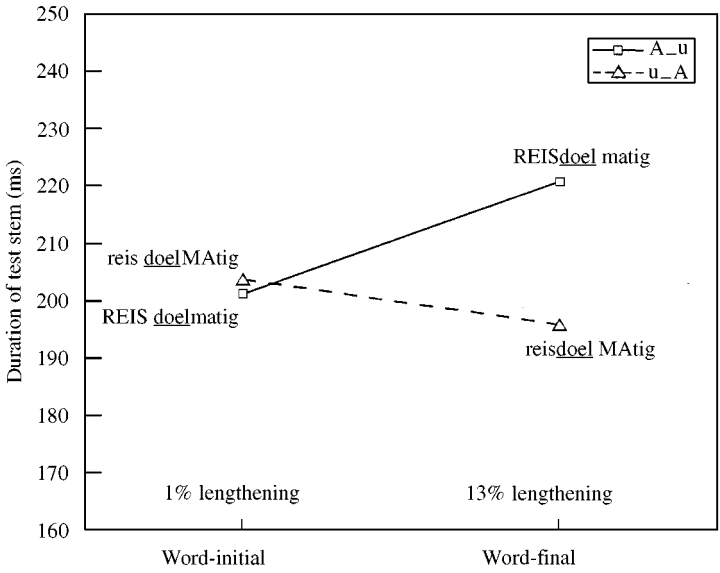

Figure 4. Results for the test stems. As Fig. 2.

word in the same accent environment: in particular, the unstressed syllable *da* is much shorter in *PAN damasten* than in *PANda masten*, because there is an intervening word boundary in the former condition.

3.5.3. *Duration of test stems*

The results for the test stems, given in Fig. 4, show the same pattern as for the test syllables. Again, an ANOVA was run with duration of the test stem as the dependent variable, fixed factors of Accent and Position, and random factors of Items and Subjects. These analyses showed a main effect of Accent (by Items: $F(1,9) = 18.79$; $p < 0.01$, by Subjects: $F(1,7) = 5.97$, $p < 0.05$), no main effect of Position (by Items: $F(1,9) = 4.36$; $p < 0.07$, by Subjects: $F(1,7) = 1.20$, n.s.), and a significant interaction between Position and Accent (by Items: $F(1,9) = 47.36$; $p < 0.01$, by Subjects: $F(1,7) = 36.26$, $p < 0.01$).

Planned comparisons for each Position (Fixed factor: Accent, Random factors: Items and Subjects) show that stems in word-initial position are not affected by Accent condition (by Items: $F(1,9) < 1$, by Subjects: $F(1,7) < 1$), while stems in word-final position are (by Items: $F(1,9) = 60.92$; $p < 0.01$, by Subjects: $F(1,7) = 22.48$; $p < 0.01$).

3.5.4. *Duration of test function words*

Finally, in Fig. 5, the results for each function word are given per accent condition. An ANOVA with Function word duration as dependent variable, Accent and Function word (*de*, *een*, *hem*, *ze*) as fixed factors and Items-Within-Function-word and Subjects as random factors show no significant effect of Accent (by Items-Within-Function-word: $F(1,16) = 3.02$, n.s., by Subjects: $F(1,7) = 3.90$, $p = 0.09$), and a clear effect of Function word (by Items-Within-Function-word: $F(3,16) = 13.72$; $p < 0.01$, by Subjects: $F(3,21) = 73.97$; $p < 0.01$). The lack of a significant effect of Accent suggests that the function word falls outside of the domain of accentual lengthening. The lack of an interaction

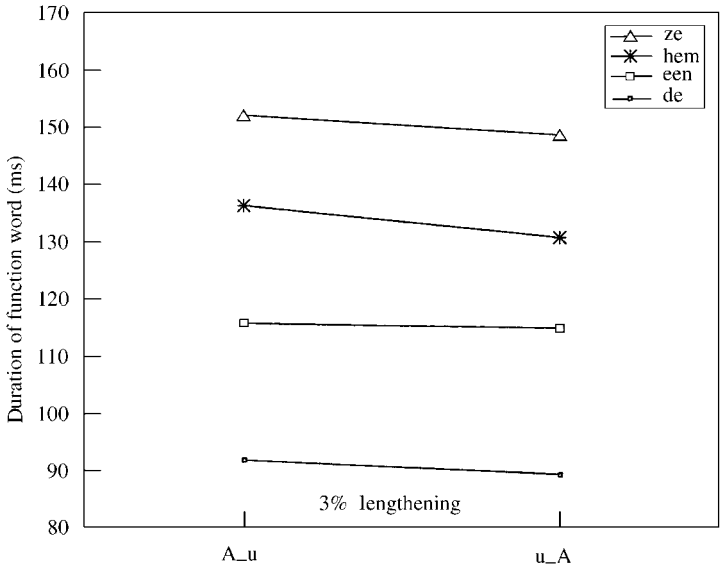

Figure 5. Results for the test function words. The effect of Accent on the duration of each of the four function words included in the experiment, averaged across items.

between Accent and Function word (by Items-Within-Function-word: $F(3, 16) < 1$; by Subjects: $F(3, 21) < 1$) shows that the two articles (*de* and *een*) do not behave any differently than the two object pronouns (*hem* and *ze*); thus, there is no effect of the direction in which the function words are syntactically affiliated.

The actual outcomes (in ms) for each of the test units and of the first and second stressed units can be found in Appendix B.

3.6. *Discussion*

The experiments described above confirm some previous conclusions on accentual lengthening in Dutch, and give some new information. The results may in some cases seem to contradict the conclusions reached by other researchers, but these apparent discrepancies can be traced back to differences in experimental design.

The experimental conditions which were used by Turk & Sawusch (1997), and replicated here, were formed around *un*stressed (and unaccented) syllables, on the assumption that a pitch accent lengthens at least the syllable with which it is associated. This assumption was checked both in Turk & Sawusch and in the present investigation by taking the segment as the first test unit. Onset and coda consonants were indeed found to be lengthened, as found earlier by Eefting (1991), so that the observation that at least the whole accented syllable is lengthened is confirmed.

Moving on to the word level, we found that unstressed syllables to the right of the pitch accent were lengthened more than unstressed syllables to the left. This contradicts the claim that accentual lengthening spreads evenly across the entire word. Still, the contrast between the conclusions drawn from the previous work on Dutch and our own results is not as great as it may seem. Analogous to the discussion in Section 2.3

on the differences and similarities between the previous Dutch and English studies, the present results may still be in line with other data on Dutch, since the differences may be explained by the different unaccented conditions which were used.

Both in the Turk & Sawusch English data (Fig. 1) and in the Dutch data presented here (Figs. 3 and 4), an unstressed syllable is found to be shortest when it precedes the accent and is outside the accented word, and longest when it follows the accented syllable within the accented word. The other two conditions lead to intermediate durations. As Turk & Sawusch note (see Section 2.2), this suggests that there may be a small leftward effect within the word as well as a small rightward effect crossing a word boundary. The former effect is supported by other data on Dutch (e.g., Sluijter & van Heuven, 1995, 1996), which show that initial syllables are indeed also lengthened when compared to an unaccented baseline condition. Turk & White (1999) found a small yet significant lengthening effect crossing a right-hand word boundary in English, when the lengthening in the A#_u condition is compared to a baseline (u#_u) condition. Although in our data there is no significant rightward effect crossing a word boundary (comparing A#_u with u_#A, i.e., the rightward *vs.* the leftward effect crossing a word boundary), there is a small difference in means (2–5 ms) which is consistent with the English findings. We found such a tendency not only in the test syllable and test stem data, but also in the test function word data (Fig. 5): the function word is on average 3 ms (3%) longer when it follows the accent than when it precedes the accent. Our data are therefore consistent with other Dutch and English studies which found a relatively small leftward effect within the accented word and a small rightward effect crossing a word boundary.

Even though accentual lengthening was assumed to spread throughout the word, the effect of a word boundary was never explicitly investigated for Dutch in the previous literature. The effect of a word boundary between two content words was tested in the material surrounding the segment, syllable and stem test units. An unstressed unit was consistently affected less by the accent when it did not belong to the accented word, thus showing that a word boundary at least attenuates the spreading of accentual lengthening.

The boundary between a content word and a function word was investigated by including the function word as a test unit. Since there was no baseline condition without any accent in the immediate vicinity, we cannot tell directly whether the word boundary has an attenuating or blocking effect. Still, since function words can only be cliticized to the left *or* to the right, lengthening of a clitic due to a pitch accent on its host would yield lengthening in only one accent environment (e.g., in the A_u environment if the function word had cliticized to the left). The lack of an effect of accent environment suggests that function words fall outside the domain of accentual lengthening. However, the present data cannot exclude the fact that function words form one accentual lengthening domain with a following content word (i.e., that they are like word-initial syllables), since in the present design neither function words nor word-initial syllables show a significant effect of accent environment. Further research is needed to determine whether function words are outside the domain of accentual lengthening or whether they are like word-initial unstressed syllables (i.e., they would show lengthening with respect to a condition with no accent in the immediate vicinity).

We compared the durational behavior of function words which had a closer syntactic affiliation with a preceding content word with the behavior of function words which had a closer syntactic affiliation with a following content word. However, no clear lengthening effects were found; it is therefore not surprising that we found no difference between function words.

The results for the test stems did not differ from those for the test syllables, despite the prosodic word boundary which occurs between two stems in a compound. This type of boundary apparently has no influence on the spreading of accentual lengthening. We will elaborate on this topic in the next section.

4. General discussion and conclusions

4.1. *Comparing accentual lengthening in Dutch and English*

The present investigation emphasizes the importance of taking heed when making cross-linguistic claims based on different studies. Especially when there are different research questions involved, the experimental conditions may differ in ways which can be hard to pin down, yet lead to results other than identical conditions would have led to. In fact, even when a study is explicitly carried out to allow for cross-linguistic comparison, the languages under investigation may differ in other aspects which can complicate the comparison. Accentual lengthening within the accented word has proved to be a good example of a case in which these difficulties occur.

A close look at the previous Dutch and English experiments led us to believe that further experiments were needed to confirm or refute the claim that Dutch and English have different domains of accentual lengthening, a claim made explicit in Turk & Sawusch (1997). Their design was therefore applied to Dutch in the experiments described in this paper. This study has shown that identical experimental designs lead to highly similar results in Dutch and English concerning the distribution of accentual lengthening. Taking all the data on accentual lengthening in Dutch and English into account we come to a description of the distribution of accentual lengthening which requires more than just a definition of the domain of accentual lengthening. There is not just one domain within which the lengthening is spread out evenly and outside of which no lengthening can be found. Besides the accented syllable, within which all segments are lengthened, a relatively large amount of lengthening is also found on syllables to the right of the accented syllable within the word. Some lengthening may also be found on syllables to the left of the accented syllable within the word, but not nearly as much as on syllables to the right. Some of the rightward lengthening may cross a word boundary to the initial syllable of a following word, although the size of this effect may be negligible. Crucially, the available Dutch *and* English data are in line with this description, suggesting that these languages do not have different domains of accentual lengthening.

One objective of the current investigation was to complete the picture on accentual lengthening in Dutch by investigating the leftward and rightward spreading more precisely. In the previous work on Dutch, possible directional effects were confounded with positional effects, since syllables to the left of the accented syllable were always word-initial, while syllables to the right of the accented syllable were always word-final. In the Turk & Sawusch design applied here, the test syllable is placed between two stressed syllables, one of which is accented, and the test syllable shares word membership with either the preceding stressed syllable (making it word-final) or the following one (making it word-initial). Consequently, directional effects can be separated from effects of position in the word, even though another confounding factor is introduced: 'leftward' lengthening always coincides with accent on the second stressed syllable, and 'rightward' lengthening coincides with accent on the first stressed syllable.

TABLE IV. Lengthening due to accent (in ms) within the stressed syllable and a neighbouring unstressed syllable

	Total amount	*First syllable*	*Second syllable*
da.MAS	27.4 ms	4.1 ms = 15% of total	23.3 ms
doel.MA	21.0 ms	2.5 ms = 12% of total	18.5 ms
PAN.*da*	48.9 ms	30.5 ms	18.4 ms = 38% of total
REIS.*doel*	59.1 ms	34.2 ms	24.9 ms = 42% of total

To begin with, we did not expect problems with this confounding of leftward/rightward spreading and position of the accented word in the phrase, and the Turk & Sawusch design has as an additional advantage that it compares unstressed syllables with the same segmental content, as opposed to the previous Dutch studies. However, in the course of the experiments described in this paper, we stumbled across what seems to be an effect of position in the phrase on the amount of accentual lengthening on the accented syllable. Subsequent research confirms that there is an interaction between position in the phrase and the amount of accentual lengthening in Dutch, but not in English (see Cambier-Langeveld, 1999, 2000). Importantly for our study, the different amounts of accentual lengthening found in the two positions in the present investigation are in the direction which could account for the effects observed on the test syllables: little lengthening on word-initial test syllables (in *pan#daMASten*), with 11% lengthening on *MAS*, and a large effect on word-final syllables (in *PANda#masten*), with 22% lengthening on *PAN*. Still, we believe that the different amounts of accentual lengthening on the stressed syllables cannot fully account for the directional asymmetry. First of all, there is still an asymmetry when we abstract away from absolute amounts by looking at the share that initial and final syllables receive, relative to the total amount of lengthening found on the accented syllable plus the target syllable; of the lengthening found in *daMAS* and *doelMA*, only 12–15% goes to the unstressed syllable, while 38–42% of the lengthening found in *PANda* and *REISdoel* goes to the final unstressed syllable (see Table IV).

Secondly, when the results obtained with the literally translated frame sentence (results not discussed in this paper, see Section 3.3) are compared with those presented in Section 3.5, we note that despite the increased amount of accentual lengthening on the second stressed unit, the lengthening on word-initial syllables is not increased.[6] Also, while *MAS* is not lengthened quite as much as *PAN* even with the revised frame sentence, the

[6]The results obtained with the initial frame sentence and the revised sentence for the test syllable and stem give the following lengthening percentages (crucially, the revision changes the results for the *second stressed unit* but not for the *test syllable in initial position*):

		Initial frame sentence	*Revised frame sentence*
test syllable	first stressed unit:	17% (sign.)	18% (sign.)
	second stressed unit:	4% (n.s.)	10% (sign.)
	test syllable in initial position:	1% (n.s.)	3% (n.s.)
	test syllable in final position:	7% (sign.)	12% (sign.)
test stem	first stressed unit:	17% (sign.)	16% (sign.)
	second stressed unit:	6% (n.s.)	9% (sign.)
	test stem in initial position:	1% (n.s.)	1% (n.s.)
	test stem in final position:	9% (sign.)	13% (sign.)

difference does not seem to stand in relation to the difference found between initial and final syllables, which is far more distinct. Furthermore, a close look at all available Dutch data does not suggest that a small amount of accentual lengthening on the stressed syllable leads to less lengthening on neighboring syllables; the lengthening of the unstressed syllables does not seem to bear any relation to the amount of lengthening on the stressed syllable, that is, unstressed syllables can be found to lengthen substantially while the stressed syllable is hardly lengthened and vice versa (cf. Nooteboom, 1972, Appendix A). Finally, the fact that word-initial syllables were found to be lengthened less than word-final syllables in other Dutch studies as well supports our view that the asymmetry between the leftward and rightward lengthening effect is real. However, the possibility that at least part of the directional asymmetry found in the present investigation is due to differences in the amount of accentual lengthening across positions cannot be discarded altogether. The unforeseen difference between Dutch and English in the extent to which accentual lengthening is sensitive to position within the phrase is thus an example of a language-specific property which may complicate cross-linguistic comparisons even when studies are comparable.

A more subtle difference between English and Dutch may be that the leftward effect within the word is stronger in Dutch. The effect on word-initial syllables as compared to a baseline condition was always clear in the Dutch studies, but in the English studies it was not always found to be significant. In Turk & White (1999), there is evidence of some inter-speaker variability in this respect. If the leftward effect within the word is indeed stronger in Dutch, this could perhaps explain why the asymmetry between leftward and rightward lengthening was not noticed in this language before.

4.2. *Structural influences on the distribution of accentual lengthening*

The present experiment included several types of test units in order to investigate which (prosodic) units affect the distribution of accentual lengthening. Word boundaries were found to have a clear attenuating effect, as seen in the data for all four test units. Function words did not behave like word-final unaccented words. We can thus conclude that function words (even object pronouns) do not belong to the same accentual lengthening domain as the content word that precedes them. We currently do not have sufficient evidence to know whether function words belong to the accentual lengthening domain of the following content word, although this is not the preferred direction of cliticization in Dutch (Booij, 1995). In any case, the domain of accentual lengthening is larger than a single stem, and must include both morphemes in a compound word (as was also found for English by Turk & White, 1999). The (lower) prosodic word (Selkirk, 1978; Nespor & Vogel, 1986) is thus too small a unit. At this point, it seems to be the morphological compound (which forms one *morphosyntactic/orthographic* word) whose edges attenuate accentual lengthening. Since a compound is not one prosodic word, nor necessarily constitutes a minor phrase (Selkirk, 1980) or phonological phrase (Nespor & Vogel, 1986) (i.e., the next higher constituent) by itself, the current Dutch prosodic hierarchy does not seem to provide us with a prosodic constituent which properly describes the unit (or one of the units) affecting the distribution of accentual lengthening.

Another unit which appears to be relevant in the description of the distribution of accentual lengthening is the syllable. Instead of saying that there is a directional asymmetry which lengthens syllables to the right of the accented syllable more than those to the left of the accented syllable, one could just as easily interpret the weaker leftward

effect as an attenuating effect of the left edge of a pitch accented syllable (as is done in Turk & White, 1999). In any case, it seems hard to describe the distribution of accentual lengthening without using the notion "syllable". Also, the accented syllable is generally lengthened most. Finally, within the syllable the rightward effect is *not* stronger than the leftward effect; coda consonants were even found to be lengthened less than onset consonants, especially in English. Position within the accented syllable thus has different effects on the amount of accentual lengthening on a particular unit than position within the word.

If the rhyme were a unit relevant for the distribution of accentual lengthening, we would expect consonants within the accented rhyme (coda consonants) to be lengthened more than consonants outside the accented rhyme (onset consonants). However, we found the opposite to be the case: coda consonants are lengthened *less* than onset consonants. The boundary between onset and rhyme therefore has no attenuating effect. Accentual lengthening thus appears to be influenced only by syllable structure and morphosyntactic word structure, while other types of boundaries (onset/rhyme, stem/stem) are completely transparent in this respect.

4.3. *Further issues*

In Turk & White (1999), the possibility is raised that the bulk of lengthening found between the left edge of the accented syllable and the end of the word is not due to accentual lengthening *per se*, but rather to a combination of accentual lengthening and word-final lengthening on an accented word. The reader is referred to Turk & White (1999) for a discussion of this matter. Clearly, more research concerning relative magnitudes of lengthening in the syllables and segments of polysyllabic words is needed.

A factor which may influence the effects under investigation, yet has not been included in the analysis, is pitch excursion. Although all pitch accents were of the same type, the default "pointed hat" or H*L (Gussenhoven, 1988), their size was not controlled. The relationship between the pitch excursion of a pitch accent and the magnitude of other prosodic cues to accent has remained virtually unaddressed, here and in the literature, yet the various cues to accent are likely to interact with one another in a number of possible ways. An investigation of pitch excursion in relation to durational effects of accent may prove especially enlightening now that different amounts of accentual lengthening have been found in different positions in Dutch, since these differences may or may not be directly related to differences in pitch excursion (see Cambier-Langeveld, 2000).

Finally, it should be noted that we have looked at lengthening related to contrastive nuclear accents only. It is still unclear whether these lengthening patterns also apply to non-nuclear prominences. In fact, results from Eefting (1991), where + and − accent conditions did not always convey new and old information respectively, did not always display the pattern described here (see Table I, Section 2.1). This may indicate that our results are not generalizable without further investigation.

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Appendix A: Test material

For each test item, only the word boundary positions are shown; all items also occurred with a pitch accent either on the first or on the second stressed syllable.

Regular Dutch spelling	IPA notation (other pronunciations are also possible)
Segment	
naam ijlen — na mijlen	/'naːm 'ɛilən/ — /'naː 'mɛilən/
doem eer — doe meer	/'dum 'eːr/ — /'du 'meːr/
bijt allen — bij tallen	/'bɛit 'ɑlən/ — /'bɛi 'tɑlən/
laat op — la top	/'laːt 'ɔp/ — /'laː 'tɔp/
rijp oker — rij pokər	/'rɛip 'oːker/ — /'rɛi 'poːkər/
diep in — die pin	/'dip 'ɪn/ — /'di 'pɪn/
dief ooien — die fooien	/'dif 'oːjən/ — /'di 'foːjən/
wijf oud — wij fout	/'ʋɛif 'ɑut/ — /'ʋɛi 'fɑut/
buig assen — bui gassen	/'bœyx 'ɑsən/ — /'bœy 'xɑsən/
wieg aan — wie gaan	/'vix 'aːn/ — /'vi 'xaːn/

Syllable

versie garen — ver sigaren	/'vɛrsi 'xaːrən/ — /'vɛr si'xaːrən/
dinar moedig — dien armoedig	/'dinɑr 'mudəx/ — /'din ɑr'mudəx/
torso sjalen — tor socialen	/'tɔrsoː 'ʃaːlən/ — /'tɔr soː'ʃaːlən/
moesson eindig — moes oneindig	/'musɔn 'ɛindəx/ — /'mus ɔn'ɛindəx/
Helga rage — hel garage	/'hɛlxaː 'raːʒə/ — /'hɛl xaː'raːʒə/
durfal machtig — durf almachtig	/'dʏrfɑl 'mɑxtəx/— /'dʏrf ɑl'mɑxtəx/
panda masten — pan damasten	/'pɑndaː 'mɑstən/ — /'pɑn daː'mɑsten/
hierom ringen — hier omringen	/'hiːrɔm 'rɪŋən/ — /'hiːr ɔm'rɪŋən/
Balkan toren — bal kantoren	/'bɑlkɑn 'toːrən/ — /'bɑl kɑn'toːrən/
ijver werken — ei verwerken	/'ɛivər 'vɛrkən/ — /'ɛi vər'vɛrkən/

Stem

ijsvrij blijvend — eis vrijblijvend	/'ɛisfrɛi 'blɛivənt/ — /'ɛis frɛi'blɛivənt/
zoutzee waardig — zout zeewaardig	/'zɑutseː 'vaːrdəx/ — /'zɑut seː'vaːrdəx/
reisdoel matig — reis doelmatig	/'rɛisdul 'maːtəx/ — /'rɛis dul'maːtəx/
zinvol brengen — zin volbrengen	/'zɪnvɔl 'brɛŋən — /'zɪn vɔl'brɛŋən/
randstad huizen — rand stadhuizen	/'rɑntstɑt 'hœyzən/ — /'rɑnt stɑt'hœyzən/
trouwmis plaatsen — trouw misplaatsen	/'trɑumɪs 'plaːtsən/ — /'trɑu mɪs'plaːtsən/
zoeklicht zinnig — zoek lichtzinnig	/'zuklɪxt 'zɪnəx/ — /'zuk lɪxt'zɪnəx/
noodweer spiegel — noot weerspiegel	/'noːtveːr 'spixəl/ — /'noːt veːr'spixəl/
landgoed koper — land goedkoper	/'lɑntxut 'koːpər/ — /'lɑnt xut'koːpər/
nepleer gierig — nep leergierig	/'nɛpleːr 'xiːrəx/ — /'nɛp leːr'xiːrəx/

Function word

gooi de tak	/xoːi də 'tɑk/
noem de plaats	/'num də 'plaːts/
vul de tas	/'vʏl də 'tɑs/
verf de deur	/'vɛrf də 'døːr/
stel de vraag	/'stɛl də 'vraːx/
koop een krant	/'koːp ən 'krɑnt/
kies een kleur	/'kis ən 'kløːr/
proef een saus	/'pruf ən 'sɑus/
strijk een blouse	/'strɛik ən 'blus/
zoek een plek	/'zuk ən 'plɛk/
pomp ze vol	/'pɔmp sə 'vɔl/
bak ze bruin	/'bɑk sə 'brœyn/
wek ze vroeg	/'vɛk sə 'vrux/
zet ze terug	/'zɛt sə 'trʏx/
help ze goed	/'hɛlp sə 'xut/
knip hem kaal	/'knɪp əm 'kaːl/
verf hem paars	/'vɛrf əm 'paːrs/
maak hem klein	/'maːk əm 'klɛin/
geef hem bier	/'xeːf əm 'biːr/
schrijf hem gauw	/'srɛif əm 'xɑu/

Appendix B

Duration of first and second stressed units and test units (in ms) per type of test unit, accent condition, word position (when applicable) and function word (when applicable)

		1st stressed unit	Test unit				2nd stressed unit
			Word-initial		Word-final		
Test segment	A_u	150.4	105.9		86.2		151.8
	u_A	114.8	123.1		76.3		171.2
Test syllable	A_u	232.5	154.9		171.3		235.1
	u_A	197.0	159.0		152.9		258.4
Test stem	A_u	293.2	201.4		221.1		228.0
	u_A	253.3	203.9		196.2		248.2
			de	een	hem	ze	
Test function word	A_u	290.6	91.8	115.8	136.2	152.1	265.6
	u_A	239.5	89.0	114.8	130.6	148.5	299.2