Syllable structure and tonal representation: revisiting focal Accent II in Swedish

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Abstract

This is a study of tonal representation as a function of syllable structure constituency in Swedish. The results of a production experiment indicate that the onset of the focal accent rise – which we suggest to be best represented by a bitonal LH command – is associated with the consonant onset of the post-accented syllable. Furthermore, a vowel insertion is favored in certain intervocalic consonant clusters. In light of these findings, as well a parallel study on Greek, we claim: (1) syllabification is a basic prerequisite condition in tonal analysis and intonation studies, (2) tonal targets may define syllable boundaries and hence syllabification and (3) different tonal targets may be associated with different syllable structure constituents in different languages.

Introduction

This presentation is part of a large study on syllable structure and crosslinguistic prosody. Our general hypothesis is that different types of tonal commands and related tonal targets are associated with specific syllable constituents in languages with different prosodic structures, such as standard Athenian Greek (hereafter Greek) and standard Stockholm Swedish (hereafter Swedish).

In Greek, early results have shown that tonal rises associated with lexical stress as well as focus production initiate at syllable onsets (e.g. Botinis 1989). In Swedish, Bruce's research (e.g. 1977) has shown how a lexical accent distinction is associated with the timing of a HL tonal command in relation to accented syllables, i.e. an early HL fall for accent I (acute) and a late HL fall for accent II (grave). On the other hand, sentence (or focal) accent is associated with a tonal rise (represented by a H), following the accent II fall, but no direct association with a specific syllable constituent has been suggested for simplex Accent II words. Thus, tonal analysis assumes some type of association between stressed syllables and specific tonal commands one way or another, albeit with a variety of different functions among languages.

Despite the general appeal to the syllable in tonal analysis, the notion of the syllable itself and related syllabifications remain a controversial issue. Theoretical approaches, such as the Maximum Onset Principle (MOP) and the Sonority Sequence Principle (SSP) may predict diverse syllabifications. Thus, the fairly internationalized word "pasta" is syllabified as /pa.sta/ according to MOP, as the consonant cluster /st/ is canonical at the onset of words (cf. "studio"), but as /pas.ta/ according to SSP, as there is no sonority rising between sibilant and stop sequences. On the other hand, experimental approaches have hardly provided reliable phonetic evidence. Maddieson (1985), e.g., suggests the Closed Syllable Vowel Shortening (CSVS) as a phonetic correlate of syllabification, according to which vowels are shorter in closed syllables than in open ones.

Botinis and Nirgianaki (2014, this volume) suggest tonal turning points as a tonal correlate of syllabification. In Greek, specifically, the L tonal target of LH commands in lexical as well as focus contexts is associated with syllable onset. Furthermore, a vowel segment

may be inserted between intervocalic consonant clusters. In /av'ɣo/ (‘egg’), e.g., in accordance with the tonal turning point, the intervocalic consonant cluster is heterosyllabified whereas a vowel is as a rule inserted between the consonants. This syllabification supports the SSP predictions, as there is no sonority rising between fricatives, but does not support the MOP predictions, as /vɣ/ is canonical syllable onset at lexical domain (cf. /'vɣeno/ ‘go out’).

In Swedish, two tonal commands and respective L targets may be assumed to correlate with syllabification: the L target of the accent II HL command can be expected to be reached in the vicinity of the syllable boundary; according to Bruce (1977), this L target likewise constitutes the onset of the rise resulting from the focal accent H command. The latter, as we will argue, might be better represented as a bitonal LH in accent II, instead of the established monotonal H. However, associations of tonal commands and related targets as a function of syllable structure variability have hardly been investigated. Swedish prosodic typology has a two-way binary distinction. First, a complementary quantity distinction, according to which long and short vowels are in principle followed by short and long consonants, respectively (e.g. “glass” /VC:/ ‘ice cream’ vs. “glas” /V:C/ ‘glass’ and, second, a lexical accent distinction, according to which stressed syllables carry either accent I or accent II (e.g. “tánken” ‘the tank’ vs. “tànken” ‘the thought’. Interestingly, the lexical accent distinction may take place in either type of quantity distinction. On the other hand, Swedish, much like other Germanic languages, is a fairly closed syllable structure language with a variety of branching codas and thus, any type of syllabification does not in principle violate canonical syllable phonotactics, either preceding coda or following onset ones. Thus, unlike Greek, which is a fairly open syllable language, Swedish hardly has any optimal context for vowel insertions.

In this presentation, in accordance with the above description and especially the syllabification issue in Swedish, we test the following hypotheses. *Hypothesis 1:* The L target of the lexical accent II HL tonal command correlates with consonant coda right edge. *Hypothesis 2:* This L target can also be regarded as the onset of the focal accent rise to the following H, which correlates with the consonant onset left edge. *Hypothesis 3:* No vowel insertion between intervocalic consonant clusters as a function of syllabification is favored.

Experimental methodology

In order to test the above hypotheses, a production experiment was designed. The speech material consists of eight accent II test words (Table 1) in the carrier sentence “vi säger ___ igen” (‘we say ___ again’), produced at normal tempo by six female speakers, grown up and educated in the wider Stockholm area. One speaker pronounced one of the test words idiolectically and was excluded. Each speaker produced the speech material five times and the corpus counts thus to 200 tokens (8 test words x 5 speakers x 5 repetitions = 200).

Table 1. Intervocalic consonant context and test words with respective glosses.

Context	Test words	Glosses
1. /V:l/	vila	to rest
2. /Vl :/	villa	villa
3. /Vmn/	nämna	to name
4. /Vlv/	halva	half
5. /V:vl/	tavla	board
6. /Vvl/	kravla	to crawl
7. /V:l#/	bil arv	car heritage
8. /V:#l/	bi larv	bee larva

The speech material was recorded at a sound-treated studio at the Humanities Laboratory, Lund University, and the speech analysis was carried out with Praat (Boersma & Weenink 2013). Acoustic analysis and measurements were carried out by the authors.

Results

This section presents qualitative analysis examples, followed by quantitative analysis of vowel insertions.

Qualitative analysis

In figure 1.1, the accent II HL fall in the word "vi:la" spans within the first part of the nucleus vowel. This tonal structure could be accounted for by assuming that long vowels in Swedish consist of two moras, which is also apparent in the waveform of the figure: the accent II fall in the first mora of the nucleus vowel is followed by a low tonal plateau throughout its second mora. The focal accent rise, on the other hand, spans between the left edge of the postvowel consonant and the succeeding nucleus vowel. This suggests that the onset of the focal accent rise is correlated with syllable boundary.

In figure 1.2, the accent II HL fall in the word "vil:a" spans within the nucleus vowel, which is short, and is followed by a low tonal plateau up to the middle of the postvowel consonant whereas the focal accent rise follows thereafter up to the following vowel. Thus, long consonants in Swedish, much like long vowels, seem to behave like bimoraic syllable constituents and hence heterosyllabification is evident with the two moras attached to different syllables. This analysis indicates (1) complementary tonal structure distribution in accordance with quantity functional distribution and (2) two L targets as a function of a low tonal plateau between accent II fall and focal accent rise, which indicates a bitonal LH representation, rather than a monotonal H.

In figure 1.3, the accent II and focal accent complementary tonal structure distribution fall-plateau-rise in the test word "nämna" is evident, which correlates with the nucleus short vowel, the first and second consonant of the intervocalic cluster, respectively. A vowel insertion is however also evident, which may be a means to reinforce syllable boundaries of intervocalic consonants.

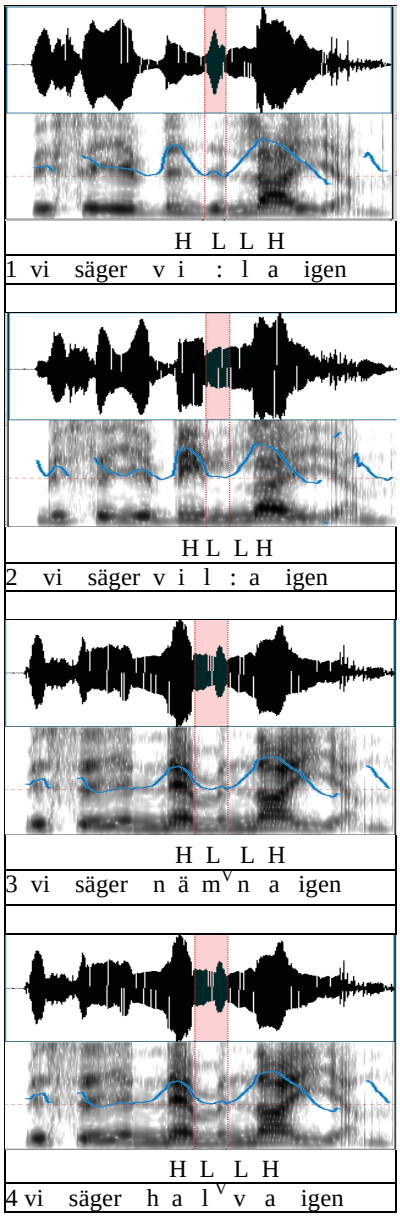

Figure 1. A female speaker's examples of tonal representations as a function of syllable structure variability (cont. next page).

In figure 1.4, the same tonal structure to that of figure 1.3 as well as a vowel insertion are apparent in the test word "halva". Thus, the accent II and

the focal fall-level-rise tonal sequence correlates with the nucleus short vowel, the first and second consonant of the cluster, respectively.

In figure 1.5, the accent II and the focal fall-plateau-rise sequence is also evident in the word “ta:vla”. However, the vowel nucleus is long, despite the heterosyllabification of intervocalic consonant cluster, which indicates that vowels in Swedish may be long even in closed syllable contexts. Furthermore, the low tonal plateau correlates with the first consonant of the cluster.

In figure 1.6, the accent II and the focal fall-plateau-rise sequence correlates with short vowel nucleus and heterosyllabic consonant cluster in “kravla”. The focal L target at the right edge of the fist consonant indicates that the words “ta:vla” and “kravla” undergo the same syllabification, despite respective long vs. short vowel nucleus.

In figure 1.7, the accent II and focal fall-plateau-rise sequence correlates with the first mora of the vowel nucleus, the second mora, and the intervocalic consonant, respectively. Thus, in analogy with tonal associations observed for “vila”, this tonal pattern indicates the expected syllabification “bi.larv”. For “bil arv” (fig. 1.8) a creaky voice at the onset of the second vowel is apparent, indicating a glottal stop and syllabification thus as “bil.arv”. The tonal pattern is somewhat inconclusive: The tonal rise at the cluster boundary may constitute the onset of the focal rise – thus indicating the same syllabification as in figure 1.7.

The qualitative analysis above revealed four key aspects of Swedish prosody. First, tonal commands and related tonal targets may be associated with specific syllable constituents. Second, a low tonal plateau intervenes between accent II and focal tonal targets. Third, the L target of the focal tonal rise is a constant correlate of syllabification. Fourth, several intervocalic clusters favor vowel insertion whereas other clusters disfavor it.

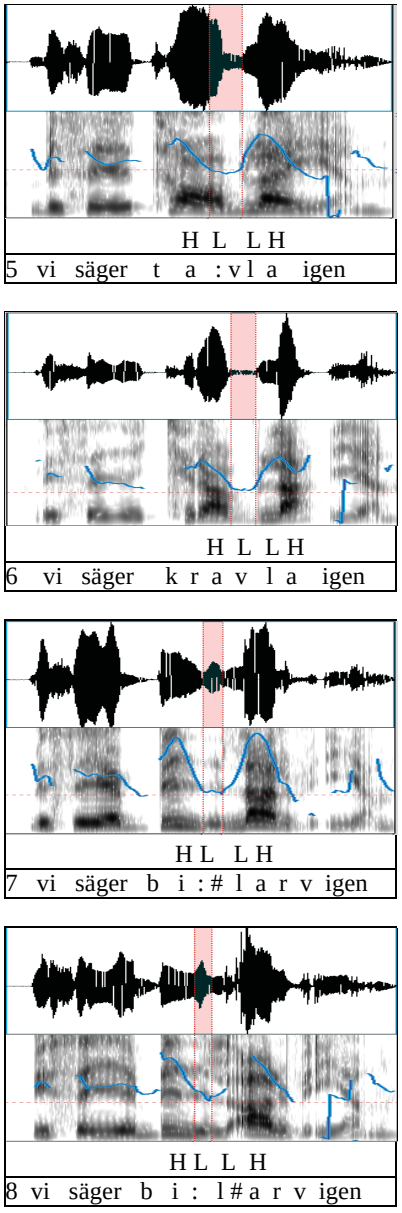

Figure 1. A female speaker’s examples of tonal representations as a function of syllable structure variability (see text).

Quantitative results

In this paper, the quantitative results are confined to vowel insertions between consonant clusters (the total results will be presented at the conference).

Table 2 shows vowel insertions as a function of phonotactic variability across intervocalic consonant sequences. In accordance with our experimental methodology, more than 20 ms of vowel-like segment insertions were considered true vowel insertions whereas less than 20 ms were considered production artifacts and are not thus included in the table. It should be noted that vowel insertion took place only in test words 3-6, which are included in table 2. Thus, no vowel insertion takes place in the context of long vowels, assuming that their internal composition consists of two moras.

Table 2. Vowel insertion in intervocalic consonant context as a function of syllable structure and phonotactic variability.

Context	Test words	Vowel insertion	
		Count	%
3. /Vmn/	nämna	16	64
4. /Vlv/	halva	23	92
5. /V:vl/	tavla	3	12
6. /Vvl/	kravla	6	24

It is evident, that vowel insertion takes place between all intervocalic consonants clusters, albeit with different percentage. Thus, the nasal-nasal as well as liquid-fricative sequences seem to favor vowel insertion whereas fricative-liquid ones disfavor it. It should be noted that MOP predicts heterosyllabification for the intervocalic cluster consonants of all test words 3-6 whereas SSP predicts heterosyllabification for words 3-4 but tautosyllabification for words 5-6. Interestingly, the SSP heterosyllabification prediction seem to favor vowel insertion in words 3-4.

Discussion

In accordance with the hypotheses posited in the introduction and the experimental methodologies, the results support Hypothesis 2, i.e. the onset of the focal rise appears to correlate with the left edge of the post-stress syllable onset. This is also evident with reference to heterosyllabification of moraic elements of long consonants, according to which the focal rise is correlated with the left edge of the second mora. At the same time, the L target of the focal rise functions as a phonetic correlate of syllabification in Swedish, which was the main aim of this study in the first place. This finding leads the way to the reconsideration and a revised tonal representation of the focal command as a bitonal LH, instead of a monotonal H. On the other hand, neither Hypothesis 1 nor Hypothesis 3 is supported, as the L target of the accent II HLcommand is correlated with the right edge of the first mora of the nucleus vowel whereas a vowel may be inserted between intervocalic consonants.

Our results further enlighten thus Bruce's (1977) tonal analysis in Swedish, according to which the lexical accent II tonal fall and the focal accent tonal rise are distinct realizations of respective prosodic functions. This was a unique approach in prosodic analysis at the time, as the accent distinction had traditionally been described as a "double-peaked" accent II versus a "single-peaked" accent I. Bruce's approach was widely adopted in tonal analysis of Swedish, suggesting a succession of accent II fall and focal accent rise: "*For a non-compound focal accent II (H*L H) the word accent II fall (tied to the stressed syllable) and the focal accent rise will typically occur in immediate succession*." (Bruce & Granström 1989, p. 18). Thus, in practice, Bruce suggested a tonal interpolation between the L target of the accent II fall and the H target of the following focal accent rise, which critically disregards the L target of the focal accent rise. In accordance with our analysis, however, this latter L target shows constant stability and we assume that its correlation with the onset syllable constituent is essential in the tonal representation of Swedish.

Bruce's analysis of Swedish had a major impact on tonal analysis and the development of prosodic theory. Thus, following Bruce (1977), Pierrehumbert (1980) suggests two tonal categories, i.e. "pitch accent" and "phrase accent",

which roughly (phonologically, but not functionally) correspond to respective lexical accent and focal accent in Swedish. In accordance with Pierrehumbert (1980) and mainstream Autosegmental-Metrical theory (AM theory) thereafter, pitch accents may be either monotonal (L* or H*) or bitonal (e.g. L*H or H*L) whereas phrase accents are in principle monotonal (i.e. either L^- or H^-). However, our results in this study contradict AM theory's premises about the monotonal representation of phrase accent (in our term focal accent), at least with reference to Bruce's analysis of Swedish and respective adoption in the context of AM theory.

Another shortcoming of AM theory is the pitch accent representation itself. The H*+L pitch accent, i.e. the accent II phonological representation in Swedish, assumes a H tonal target in the domain of stressed syllable, i.e. a starred tone, whereas the L tonal target is basically unspecified. In principle, the L tonal target of the L tone may thus be anywhere on the right of the H tone, even outside the stressed syllable itself. In practice, AM theory notation and the assumptions behind it seem thus to be too underspecified for underlying phonological representations and too broad for surface phonetic representations likewise. Instead, the association of tonal commands and respective tonal targets with specific syllable constituents, in accordance with the results of the present study, is closer to phonetic reality and matches in a natural way the phonetics and phonology of prosody. Interestingly, that is what AM theory and its basic premises advocate in practice, i.e. the relation of phonetics and phonology in the first place.

Approaches within the framework of AM theory define in alternative ways the targets of tonal associations. Atterer and Ladd (2004), e.g., suggest associations of pitch accents and respective tonal targets with segmental landmarks, i.e. specific "segmental anchorings". Although an insightful remark per se, no further elaboration is whatsoever attempted with regards to interactions of tonal representations and syllable structure constituents. Thus, to the best of our knowledge, the role of syllable structure constituency in intonation studies has practically been ignored in current prosodic research.

In our view (see also Botinis & Nirgianaki 2014, this volume), segmental strings of any length in principle are organized into syllable sequences whereas, at the same time, segments associate with syllable constituency. Underlying representations and related tonal commands, on the other hand, are optimally surfaced as specific tonal targets at specific syllable constituents. The interface between different tonal commands and different syllable domains may thus vary across languages, which is a challenging line of crosslinguistic prosody research and prosodic theory development in general.

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