

A positional analysis of quantity complementarity in Swedish with comparison to Arabic.

¹Zeki Majeed Hassan and ²Barry Heselwood

¹Department of Linguistics, University of Gothenburg, Gothenburg, Sweden

²Department of Linguistics and Phonetics, University of Leeds, Leeds, UK.

*Alphabetical order.

Abstract

The most favoured solution to the problem of quantity complementarity in Swedish has been to claim that vowel length is phonemic and consonant length is predictable (Linell, 1978). Evidence from listeners' perceptual behaviour supports this over the reverse claim that it is only consonant length which is distinctive (cited in Czigler, 1998), a position that has nevertheless been argued for (Eliasson & La Pelle, 1973). However, there is a phonological cost: the vowel inventory must be doubled. We present an analysis based on positional criteria to account for the phonetic facts reported in instrumental studies such as Czigler (1998), Hassan (2002), Strangert & Wretling (2003), without the cost of additional phonemes. It takes Trubetzkoy's (1969) 'correlation of syllable contact' and develops it according to more recent functionalist principles of phonotactic analysis (Mulder, 1989; Dickins, 1998). Vowel and consonant length are predicted by whether there is a consonant in the phonotactic position immediately following the syllable nucleus. Quantity complementarity in Swedish is compared to vowel and consonant length in Arabic and shown to bear out Hassan's (2003: 48) assertion that the phenomenon of length 'constitutes a systematic difference between the phonological systems of both languages'.

Duration and length in Swedish stressed syllables

In Swedish, stressed syllables¹ can be of three types regarding the content of their rhyme structure. This can be expressed as 'Danell's formula' (Witting, 1977):

- A) long vowel only, e.g. se 'see'
- B) short vowel + long consonant, e.g. hatt 'hat'
- C) long vowel + short consonant, e.g. hat 'hate'

It is the types B) and C) which have intrigued phoneticians and phonologists because of the relationship between the vowel and its follow-

ing consonant. From a phonetic point of view, the relationship is one of inverse co-variation of duration. Because the durational differences for both the consonants and the vowels are significantly well above the absolute difference limens (Hassan, 2002), we can say that we are dealing with length differences as well as durational differences. We therefore have inverse co-variation of phonological length – when the vowel is long, the consonant is short, and vice versa, although there is considerable variation in degree of complementarity cross-dialectally (Strangert & Wretling, 2003). As well as a long consonant, a cluster of two short consonants can follow a short vowel. Examples are given in Table 1.

Throughout this paper, discussion and exemplification will be restricted to monosyllabic forms in order to avoid the issue of where the syllable boundary is in forms such as Swedish *titta* 'to look', or Arabic *kattab* 'he made somebody write'. Also excluded are forms with a cluster of three consonants such as *svensk*, *tjänst* on the assumption that the final consonant is outside the domain of quantity complementarity. Morphological boundaries are ignored.

Table 1. Inverse co-variation of vocalic and consonantal length in Swedish stressed syllables.

Long vowel + short consonant	Short vowel + long consonant
<i>hat</i> [hɑ:t] 'hate'	<i>hatt</i> [hɑt:] 'hat'
<i>lam</i> [lɑ:m] 'lame'	<i>lamm</i> [lɑm:] 'lamb'
<i>väg</i> [vɛ:ɣ] 'road'	<i>vägg</i> [vɛɣ:] 'wall'
<i>köp</i> [ɕø:p] 'buy'	<i>köpt</i> [ɕæpt] 'bought'

As implied by the transcriptions, as well as a difference in vowel length there is also a clearly noticeable difference in vowel quality.

Although vowel quality has been found not to be robust as a perceptual cue across all short-long pairs (Behne, Czigler & Sullivan, 1996; 1998, cited in Czigler, 1998), Linell (1978) adduces it as evidence that there is a phonemic opposition between short and long vowels. The quality of consonants in terms of place and manner of articulation is, however, not noticeably affected by length. The taxing question is, how should these phonetic facts be analysed phonologically? There is not space in this paper to discuss the relative merits of all possible answers to this question, but they include, using *hatt-hat* as examples, the following:

- 1) phonemic vowel length and phonemic consonant length - /hat:/, /ha:t/;
- 2) phonemic consonant length with vowel length predictable - /hat:/, /hat/;
- 3) phonemic vowel length with consonant length predictable (Elert, 1964; Witting, 1977; Linell, 1978; Czigler, 1998) - /hat/, /ha:t/;
- 4) singleton-geminate consonant opposition with vowel length predictable (Eliasson & La Pelle, 1973; Eliasson, 1978) - /hatt/, /hat/.

Each of the above analyses seems to account equally for the phonetic facts, so we need to bring the criterion of economy of description to bear. 1) requires doubling the vowel inventory and the consonant inventory and could be rejected as an uneconomic solution. 2) requires doubling the consonant inventory but not the vowel inventory. 3) requires doubling the vowel inventory but not the consonant inventory, which is to be preferred over 2) because the vowel inventory is smaller in the first place; it is the solution favoured by most writers on the subject, following Elert (1964), although Linell (1978: 125), an advocate of this solution, admits that vowel length is 'distinctive only before single consonants'. 4) does not require any additional phonemes in the inventories, but does lead to an increase in the complexity of some of the phonological forms that take part in quantity complementarity. For example, the phonological form of *hatt* must comprise four phonemes instead of three and therefore falls foul of a phonotactic simplicity metric.

All the above analyses involve some difference in phonemic content to account for the quantity complementarity. It is worth consider-

ing an alternative approach which accounts for quantity phenomena in prosodic terms rather than in phonemic terms, and that is Trubetzkoy's correlation of syllable contact.

Trubetzkoy's 'correlation of syllable contact' analysis

Trubetzkoy (1969: 199-201) provides a prosodic analysis of quantity complementarity in Swedish instead of the kind of phonemic analyses outlined in (1)-(4) above. That is to say, the phonological difference between the pairs in table 1 and others like them is due to a prosodic opposition, not a phonemic opposition. According to Trubetzkoy, postvocalic consonants in stressed syllables in Swedish can relate to the preceding vowel with either close contact or open contact. In the case of close contact, the vowel is predictably shortened and the consonant equally predictably lengthened. In the case of open contact, the vowel is predictably long and the consonant equally predictably short. Both vowel length and consonant length are predictable and hence non-distinctive, occurring as a consequence of, respectively, open and close syllable contact. When there is no following consonant the situation is as for open contact – it is pertinent here to note that short vowels do not occur in open stressed syllables in Swedish.

Trubetzkoy's syllable contact analysis has the advantage of descriptive economy over alternatives (1)-(3) above in that it does not necessitate setting up either long vowel or long consonant phonemes in opposition to short ones. Neither does it require increasing the complexity of phonological forms as is the case in (4). However, while the phonetic lengthening of vowels in open contact is entirely plausible in order to fill what we can think of as a vacated space, Trubetzkoy's analysis fails to give an adequate explanation for why, in close contact, the postvocalic consonant is lengthened, or of why it is not lengthened when it is part of a cluster of two consonants.

A positional analysis of Swedish quantity complementarity

We propose that it is possible to recast Trubetzkoy's analysis in such a way as to retain its insights and advantages while rendering it more explanatory, and that the way to do this is to account for the distribution of phonemes in Swedish stressed syllables in terms of a frame of phonotactic positions known as a phonotagm (Mulder, 1989; Dickins, 1998). Mulder (1989: 444) explains that a phonotagm is the 'minimum type of structure within which the distri-

bution of cenotactic (natural language: phonotactic) entities can be described completely and exhaustively'. It comprises a set of positions to which the constituent phonemes of a phonological form can be assigned by functional criteria. Unlike the syllable, realisational properties of phonemes are ignored when assigning phonemes to positions. Quantity complementarity in Swedish stressed syllables can be accounted for by setting up a phonotagm with two post-nuclear positions which we shall call post-nuclear₁ and post-nuclear₂. Together with the nucleus itself (the 'identity element' of a phonotagm), this is somewhat analogous to the three rhyme 'X-slots' set up for English by Giegerich (1992). The nucleus is always occupied by a vowel phoneme, while the post-nuclear positions can either be phonologically empty or occupied by a consonant phoneme. Examples are given in table 2.

Table 2. Positional analysis of quantity complementarity

onset	nucleus	post-nuclear ₁	post-nuclear ₂
s	ɛ		
h	a	t	
h	a		t
v	ɛ	g	
v	ɛ		g
ʧ	ø	p	t
ʧ	ø		p

A generalised realisation statement to the effect that an empty position is filled by the phonetic material from the preceding position accounts for the phonetic facts.

Positional analysis gives a coherent phonotactic interpretation to Trubetzkoy's 'syllable contact' analysis. Close contact is equivalent to the consonant occupying POST-NUCLEAR₁, and open contact equivalent to its being in POST-NUCLEAR₂. The advantage over Trubetzkoy's analysis is that we can explain the lengthening of the vowel in rhyme types A and C, and the lengthening of the consonant in rhyme type B,

in the same terms. It also accounts for why a consonant in POST-NUCLEAR₁ does not lengthen if it is part of a cluster, i.e. if there is another consonant in POST-NUCLEAR₂. It shares with Trubetzkoy's analysis the advantage of not having to set up additional phonemes in the inventory of Swedish because it renders both vowel and consonant length predictable and therefore non-distinctive. The opposition between pairs such as *hat-hatt* etc. is set up purely as a phonotactic difference – the phonological forms comprise the same phonemes, but distributed differently in the phonotactic frame.

Comparison to vowel and consonant length in Arabic

The situation regarding vowel and consonant length in Arabic is rather different and does not lend itself to the analysis proposed above for Swedish. While there is evidence of inverse co-variation of duration between consonants and vowels in the Iraqi Arabic data examined by Ghalib (1984) and Hassan (1981, 2002), whether this extends to inverse co-variation of length is not so clear. According to Hassan (2002), vowel duration differences before singleton and geminate consonants do not significantly exceed difference limen values. In this he is in agreement with Ghalib (1984) who also concluded that such vowel duration differences are negligible.

The really important difference between Arabic and Swedish in respect of quantity concerns predictability. Above we presented a positional analysis in which Swedish quantity is predictable on the basis of the contrastive distribution of phonemes within the phonotagm. The reason this analysis works is that there are no stressed syllables in Swedish of the type CV:C:² or CVC. Arabic presents a different picture because these types do exist in opposition to CVC: and CV:C. In fact in Arabic it appears that all combinations of short and long vowels and consonants can occur in stressed syllables. Mitchell (1990: 65) gives the minimal pair example /s̄ aam/ 'year' and /s̄ aamm/ 'public' showing that consonant length is distinctive after a long vowel, and Hassan (2003: 45-6) provides /samm/ 'poison' and /saamm/ 'poisonous' to show that vowel length is distinctive before a long consonant. There is therefore no inverse co-variation of quantity in Arabic: vowel quantity and consonant quantity

vary independently and neither can be predicted from knowing the other. This, we suggest, bears out Hassan's (2003: 48) contention that quantity in Swedish and Arabic 'constitutes a systematic difference between the phonologies of both languages'.

Notes

1. By 'stressed syllable' we mean one that is not unstressed, i.e. it includes secondary stress (or what has been called 'reduced main stress') as well as primary stress.

2. Witting (1977) cites moln 'cloud' as an example of CV:CC to argue that vowel length is not predictable when followed by a cluster, but the pronunciation [mo:ln] is described as a 'regional exception' by Czigler (1998: 23) and marked as an exception by Linell (1978: 123), we therefore discount it.

References

- Behne, D.M., Czigler, P.E. & Sullivan, K.P.H. (1996) Acoustic characteristics of perceived quantity in Swedish vowels. *Speech Science and Technology* '96, (Adelaide), 49-54.
- Behne, D.M., Czigler, P.E. & Sullivan, K.P.H. (1998) Perceived vowel quantity in Swedish: effects of postvocalic voicing. *Proceedings of the 16th International Congress of Acoustics and the 135th Meeting of the Acoustical Society of America*, (Seattle), 2963-64.
- Czigler, P.E. (1998) Timing in Swedish VC(C) sequences. *PHONUM* 5, Dept of Phonetics, Umeå University.
- Dickins, J. (1998) *Extended Axiomatic Linguistics*. Berlin: Mouton de Gruyter.
- Elert, C.-C. (1964) *Phonologic Studies of Quantity in Swedish*. Uppsala: Almqvist & Wiksell.
- Eliasson, S. (1978) Swedish quantity revisited. In Gårding, E., Bruce, G. & Bannert, R. (eds) *Nordic Prosody*. Dept of Linguistics, Lund University. 111-122.
- Eliasson, S. & La Pelle, N. (1973) Generative regler för svenskans kvantitet. *Arkiv för nordisk filologi* 88, 133-148.
- Giegerich, H.J. (1992) *English Phonology*. Cambridge: Cambridge University Press.
- Ghalib, G.B.M. (1984) An experimental study of consonant gemination in Iraqi Spoken Arabic. Unpublished PhD Thesis, University of Leeds.
- Hassan, Z.M. (1981) An experimental study of vowel duration in Iraqi Spoken Arabic. Unpublished Ph.D. Thesis U.K: Dep. of Linguistics & Phonetics, University of Leeds.
- Hassan, Z.M. (2002) Gemination in Swedish and Arabic with a particular reference to the preceding vowel duration: an instrumental and comparative approach. In *Proceedings of Fonetik 2002 TMH-QPSR* 44, 81-85.
- Hassan, Z.M. (2003) Temporal compensation between vowel and consonant in Swedish & Arabic in sequences of CV:C & CVC: and the word overall duration. *PHONUM* 9, 45-48, Dept of Phonetics, Umeå University.
- Linell, P. (1978) Vowel length and consonant length in Swedish word level phonology. In Gårding, E., Bruce, G. & Bannert, R. (eds) *Nordic Prosody*. Dept of Linguistics, Lund University. 123-136.
- Mitchell, T.F. (1995) *Pronouncing Arabic*. Oxford: Clarendon Press.
- Mulder, J.W.F. (1989) *Foundations of Axiomatic Linguistics*. Berlin: Mouton de Gruyter.
- Strangert, E. & Wretling, P. (2003) Complementary quantity in Swedish dialects. *PHONUM* 9, 101-104, Dept of Phonetics, Umeå University.
- Trubetzkoy, N.S. (1969) *Principles of Phonology*. Berkeley: University of California Press.
- Witting, C. (1977) *Studies in Swedish Generative Phonology*. Stockholm: Almqvist & Wiksell.