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ON RHYTHMIC ALTERNATION

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ABSTRACT

Rhythmic alternation among sequences of unstressed syllables in Swedish utterances was examined from both phonological and phonetic starting points. This alternation between strong and weak syllables was found to be determined by the location of the actual stressed syllables. Generally, the unstressed syllables will be alternatively weak and strong starting from the upcoming stress and counting backwards. Phonetically this is reflected as an alternation in relative durations between successive syllables. I suggest that the division into weak and strong unstressed syllables in addition to the division into stressed and unstressed syllables is an important aspect of speech rhythm in Swedish.

1. PROBLEM

The present paper is a preliminary study of speech rhythm in Swedish where the objective is to explore the nature of rhythmic alternation.

Speech rhythm seems to be one of the most problematic topics in contemporary phonetics and phonology. There is far-reaching agreement about the importance of rhythm in spoken language, but when it comes to more precise statements about what speech rhythm really is and where it is, the disagreement among scholars in the field becomes evident.

The phonetic study of speech rhythm has led to the postulation of isochrony as one expression of speech rhythm and the division of languages into syllable-timed and stress-timed (see e.g. Pike 1945, pp. 34 ff.). The maintenance of (nearly) constant inter-stress intervals independent of the number of intervening unstressed syllables defines isochrony in stress-

timed languages, e.g. Germanic languages.

Most production studies of isochrony show, however, at best a tendency towards isochrony which has led to the assumption that isochrony is primarily a perceptual phenomenon (Lehiste 1973,1977, Allen 1975); cf. e.g. Lehiste's observation "that listeners tend to hear utterances as more isochronous than they really are,..." (Lehiste 1980, p. 252) and the discussion of the isochrony issue in the temporal symposium at the phonetics congress in Copenhagen 1979.

My own approach to the study of speech rhythm is somewhat different. I have chosen to study what is known as rhythmic alternation, trying to relate this concept to a general definition of rhythm such as the one formulated by the psychologist Woodrow (1951, p. 1232):

> "By rhythm, in the psychological sense, is meant the perception of a series of stimuli as a series of groups. The successive groups are ordinarily of similar pattern and experienced as repetitive. Each group is perceived as a whole and therefore has a length lying within the psychological present."

For spoken language I assume that a series of syllables will be arranged according to a principle of rhythmic alternation, alternation between strong(er) and weak(er) syllables. This will create groups and subgroups of syllables of similar structure, which is thought to constitute an important aspect of speech rhythm. It is my bias in thinking about rhythm in spoken language that the leading principle is alternation and not isochrony.

The goal of the present study is to examine rhythmic alternation from both phonological and phonetic starting points, i.e. to try to find out what rules govern the occurrence of rhythmic alternation and what are its phonetic reflexes.

2. THE PHONOLOGY OF RHYTHMIC ALTERNATION

The rhythm of an utterance in Swedish is determined mainly by the stress patterns of the actual, prominent words, i.e. how stressed and unstressed syllables are distributed in these words. In the presentation here I will make a distinction between lexical and actual stress. The lexical stress, attributed to each lexical item, may or may not be actualized in an

utterance depending on intricate context factors. When nothing else is indicated, stress will mean actual stress. It is a well-known fact that it is primarily the content words that will carry stress in an actual utterance, while the form words often appear unstressed.

The rhythm of an utterance is, however, partly determined by other factors as well. The tendency towards a rhythmic alternation is assumed to be one such factor.

Rhythmic alternation seems to occur in two kinds of situations:

(1) One situation is when two or more stresses would clash in an utterance. Under certain conditions one of the stresses will yield resulting in a rhythmic alternation among the syllables involved. A stress shift is said to take place in order to avoid a clash of stress. A classical example of the avoidance of stress-clash in English is the word thirtéen with final stress in isolation but with the opposite stress pattern in certain contexts, e.g. thírteen mén (cf. e.g. Liberman & Prince 1977). A corresponding Swedish example, also classical, contains the word kaptén 'captain' with final stress in isolation, but with the stress shifted in the context kápten Àndersson 'captain Andersson' (cf. Malmberg 1966, p. 95).

Although a clash of two stressed syllables may result in a rhythmic alternation, as above, the normal case, at least for Swedish, is to still maintain an unchanged sequence of two stressed syllables.

In a stress-clash situation consisting of three consecutive syllables, a rhythmic alternation is more common. While in the example Jan såg 'Jan saw' we usually have two consecutive stressed syllables, it is at least unusual that in Jan såg Bo 'Jan saw Bo' såg will retain its stress. Normally a rhythmic alternation will occur.

It is possible that in certain sequences of three (or more) stresses like tripp, trapp, trull 'tick-tack-toe' or en, två, tre 'one, two, three', where no syntactic groupings will elicit specific subphrases, you may find three equally prominent syllables. But also for these kinds of constructions I believe it is customary to have a rhythmic alternation, where the middle stress is weakened.

(2) The other situation which calls for rhythmic alternation is when several unstressed syllables form a sequence. In this case a rhythmic alternation among the unstressed syllables as strong and weak will occur forming groups consisting of two (or three) syllables with one more prominent syllable per group. This tendency towards a rhythmic alternation among unstressed syllables is known from long, oxytonic words, e.g. Swedish demokráti 'democracy', konstitutionéll 'constitutional', where the integers 1 and 0 indicate an alternation between strong and weak unstressed syllables and 4 denotes primary stress (cf. Elert 1970, p. 37).

It is reasonable to believe that this alternation is typical not only of single words but of any succession of several unstressed syllables that forms a unit of speech, more or less independent of word boundaries.

The principle of rhythmic alternation entails a conspiracy against sequences of several equally prominent syllables. This applies to both unstressed and stressed syllables.

In the present paper I will concentrate on (2), the rhythmic alternation among sequences of unstressed syllables.

In the following I will try to make the simplest possible assumptions to account for rhythmic alternation. I assume that rhythmic alternation is a process that is triggered by the immediate prosodic context, i.e. no access to a hierarchical tree structure à la Liberman & Prince (1977) is needed. This also seems to be in line with the reasoning by Liberman & Prince, who described the rhythm rule for clash of stress involving a rhythmical alternation in terms of a metrical grid, which is based on a metrical tree structure but does not in itself encompass any constituent structure.

Thus, the relevant input knowledge for the rhythmic alternation rule is the location of the stresses in the actual prominent words. For the present study I will simply assume that the location of these stresses is known. The division of successive syllables into stressed and unstressed is considered part of the rhythmical organization of an utterance. The phonological matrices below used to illustrate the operation of the rhythmic alternation rule also contain information about rhythmical

strength. As part of the input knowledge I assume that stressed is rhythmically strong and unstressed rhythmically weak. It should be noted that strong and weak as used in metrical theory (Liberman & Prince 1977) do not have these implications. I will use strong and weak to describe the rhythmic alternation among unstressed syllables.

A preliminary formulation of the rhythmic alternation principle is the following: Give the value strong to every second unstressed syllable counting from the closest stressed syllable.

For the two examples below with an odd number of unstressed syllables between the stresses, we have the following rhythmical structure:

(1)

	input string								output string								
	kompisar		me		tjeckerna				kompisar		me		tjeckerna				'friends with the Czechs'
stress	+	–	–	–	+	–	–	→	+	–	–	–	+	–	–		
strength	+	–	–	–	+	–	–		+	–	+	–	+	–	+		

(2)

	input string								output string								
	kompisar		me		kapital				kompisar		me		kapital				'friends with capital'
stress	+	–	–	–	–	–	+	→	+	–	–	–	–	–	+		
strength	+	–	–	–	–	–	+		+	–	+	–	+	–	+		

For an example with an even number of unstressed syllables between the stresses, e.g. four as in the example below, the preliminary rule will generate the following structure:

(3)

	input string								output string								
	kompisar		me		soldater				kompisar		me		soldater				'friends with soldiers'
stress	+	–	–	–	–	+	–	→	+	–	–	–	–	+	–		
strength	+	–	–	–	–	+	–		+	–	+	+	–	+	–		

Although this seems to be a possible rendition of the actual utterance, it is according to my analysis not the most normal one. Instead the normal rendition of (3), at least in running speech, seems to be:

(3')

	output string							
	kompisar		me		soldater			
stress	+	–	–	–	–	+	–	
strength	+	+	–	+	–	+	–	

That the actual location of word boundaries is irrelevant to the rhythmic pattern and that it is the number of unstressed syllables between the stresses that is crucial is evidenced by

the following example, also with four syllables, but with another location of word boundaries:

(4)	input string		output string	
	soldater me kapital		soldater me kapital	'soldiers with capital'
stress	- + - - - - +	→	- + - - - - +	
strength	- + - - - - +		- + + - + - +	

Therefore the rhythmic alternation principle has to be reformulated as: Give the value strong to every second, unstressed syllable counting backwards from the upcoming stress to the preceding stress. Give also strong to every second, unstressed syllable after the final stress of the actual speech unit.

This rule will introduce a rhythmical shift after each stressed syllable which is followed by an even number of unstressed syllables before the following stress. Thus, the reformulated rule will give the following structure to a sequence of two unstressed syllables between the stresses as in the following example:

(5)	input string		output string	
	attentat me soldater		attentat me soldater	'attempt with soldiers'
stress	- - + - - + -	→	- - + - - + -	
strength	- - + - - + -		+ - + + - + -	

A retention of the preliminary rule would have created a conflict of adaptation for the two unstressed syllables in (5), i.e. whether to adapt to the preceding or the following stress, which does not occur with the reformulated rule.

Sequences containing an uneven number of unstressed syllables between the stresses, e.g. one, three or five, seem to be less problematic from a rhythmical point of view. They fit rhythmically both to the preceding and the following stress, while sequences with an even number of unstressed syllables, e.g. two or four, are rhythmically uneven and necessitate a rhythmical shift.

In this preliminary investigation I have only studied the most simple structures in the rhythmic alternation, the subgroups consisting of one strong and one weak syllable, while the rhythmical grouping of two consecutive weak syllables between two strong syllables remains to be taken into consideration.

One interesting implication of the alternation principle, as it has been formulated here, is that the same unstressed syllable may appear strong or weak depending on the actual context, i.e. its position in relation to the upcoming stress. This observation was an unexpected finding for me, but having gone through a number of similar examples, I have become convinced of its correctness. So in the two examples repeated here for convenience, we find that the syllable sar is strong in (1) and weak in (3):

	(1) output string							(3) output string						
	kompisar			me		tjeckerna		kompisar			me	soldater		
stress	+	-	-	-	+	-	-	+	-	-	-	-	+	-
strength	+	-	+	-	+	-	+	+	+	-	+	-	+	-

So far we have been discussing examples where the stressed syllables belong to separate words. If we instead turn to compound words, it appears that the rhythmic alternation principle works in exactly the same way.

Although a compound may be composed of several elements, each containing a lexical stress, I assume that in the input string of the actual compound word accessible to the rhythmic alternation rule only the first and the last stress of the compound will be present.

While in the example Sw. hov-rätt 'court of appeal' the second element of the compound has stress, this stress will not necessarily surface in a longer compound such as hovrätts-president 'president of a court of appeal' or hovrätts-fiskal 'public prosecuter of a court of appeal'. Although rätt will count as unstressed in both these compounds, it will appear weak in the first and strong in the second example according to the rhythmic alternation rule:

(6)	input string								output string							
	hovrättspresident								hovrättspresident							
stress	+	-		-	-	+		→	+	-		-	-	+		
strength	+	-		-	-	+			+	-		+	-	+		

(7)	input string								output string							
	hovrättsfiskal								hovrättsfiskal							
stress	+	-		-	+			→	+	-		-	+			
strength	+	-		-	+				+	+		-	+			

Another similar pair of examples but with another location of the internal word boundary is utbildnings-ledare 'education leader' and utbildnings-minister 'minister of education' with the following rhythmical structures:

(8)	input string							output string						
	utbildningsledare							utbildningsledare						
stress	+	-	-		+	-	-	→	+	-	-		+	-	-
strength	+	-	-		+	-	-		+	+	-		+	-	+

(9)	input string							output string						
	utbildningsminister							utbildningsminister						
stress	+	-	-		-	+	-	→	+	-	-		-	+	-
strength	+	-	-		-	+	-		+	-	+		-	+	-

A final example, demonstrating that the rhythmical structure of the compund elements in isolation does not necessarily determine the resulting rhythmical pattern in the compound is utrikes-departementet 'State Department'. Here the elements as independent words would come out as:

(10)	output string				(11)	output string				
	utrikes 'foreign'					departementet 'Department'				
stress	+	+	-			-	-	-	+	-
strength	+	+	-			+	-	-	+	-

In the compound word, however, the location of strong and weak syllables between the stresses will be shifted relative to the above rhythmical structure in the compound elements:

(12)	input string										output string									
	utrikesdepartementet										utrikesdepartementet									
stress	+	-	-		-	-		-	+	-	→	+	-	-		-	-		-	+	-
strength	+	-	-		-	-		-	+	-		+	-	+		-	+		-	+	-

It is even possible that the so-called clash-of-stress phenomenon described above is not distinct from the rhythmical alternation among unstressed syllables discussed here. At least in the Swedish examples it is tempting to conceive of kaptén with lexical final stress in the context kápten Åndersson as occurring unstressed and subject to the principle of rhythmic alternation. Accordingly, in the actual example the kap-syllable will appear strong, while in kapteń Molín 'captain Molin' - Molín having final stress - the ten-syllable is the strong one.

Summing up so far, we have demonstrated that the rhythmic alteration among sequences of unstressed syllables appears to be determined by the location of the stressed syllables in the actual prominent words of an utterance. A stressed syllable functions as a line-up point in the rhythmical structure, after which a rhythmical shift may take place. The alternation seems to be adapted to the upcoming stress so that going backwards from a stressed syllable the syllables will be alternatively weak and strong up to the preceding stress or to the beginning of the utterance.

Thus the phonological analysis of rhythm presented here gives us three types of syllables from a rhythmical point of view: $\left[\begin{smallmatrix}+\text{ stress}\\+\text{ strong}\end{smallmatrix}\right]$, $\left[\begin{smallmatrix}-\text{ stress}\\+\text{ strong}\end{smallmatrix}\right]$, $\left[\begin{smallmatrix}-\text{ stress}\\-\text{ strong}\end{smallmatrix}\right]$. This means that the basic rhythmical division into stressed and unstressed syllables forming successive stress groups is supplemented by a division of the unstressed syllables into subgroups consisting optimally of one strong and one weak syllable.

3. THE PHONETICS OF RHYTHMIC ALTERNATION

The next issue to account for is how the rhythmical structure of an utterance, the rhythmic alternation, is expressed phonetically. My expectation is to find reflexes on the phonetic surface of the rhythmic alternation between strong and weak unstressed syllables as alternating relatively longer and shorter syllable durations.

A pilot experiment was conducted to give a preliminary and partial answer to the question of the phonetic reflex of rhythmic alternation.

3.1 Test material

In the test material used for this pilot experiment the distance between two stressed syllables with accent 1 in terms of the number of unstressed syllables was varied from one to five, while the total number of syllables per utterance was held constant. The test material contains the following original sentences:

1. kompisar me tjeckerna - ∪ ∪ ∪ - ∪ ∪ 'friends with the Czechs'
2. kompisar me soldater - ∪ ∪ ∪ ∪ - ∪ 'friends with soldiers'
3. kompisar me kapital - ∪ ∪ ∪ ∪ ∪ - 'friends with capital'
4. soldater me kapital ∪ - ∪ ∪ ∪ ∪ - 'soldiers with capital'
5. attentat me kapital ∪ ∪ - ∪ ∪ ∪ - 'attempt with capital'
6. attentat me soldater ∪ ∪ - ∪ ∪ - ∪ 'attempt with soldiers'
7. attentat me tjeckerna ∪ ∪ - ∪ - ∪ ∪ 'attempt with the Czechs'

Thus, the test material contains one sentence with one, two with three, two with four and one with five unstressed syllables between the stresses.

3.2 Method

Each test sentence was first recorded in its original form and then in so-called reiterant speech form immediately afterwards (Liberman & Streeter 1978), matching the syllables of the original sentence by the iteration of stereotypic syllables.

The problem of studying speech rhythm in real speech is that it is not directly accessible from the physical signal. In order to be able to extract the reflexes of speech rhythm in the consecutive syllable durations of an utterance, the segment structure of these syllables has to be controlled. In normal speech there is considerable variation in the segmental structure of the actual syllables (cf. e.g. Klatt 1976). There may be differences in such things as open vs. closed syllables, cluster size, vowel quality with different inherent length, voiced vs. voiceless consonants, etc., all contributing to the bias of the internal make-up of the syllables which may obscure the speech rhythm in the physical signal. It is commonly assumed that the human mind can compensate for such intrinsic phenomena.

In order to avoid problems of interpretation of this sort, I chose reiterant speech with stereotypic, open syllables. In my experiment I used as alternation between ba- and da-syllables replacing the syllables of the original sentence in the reiterant version of the sentence. The choice of two alternating instead of one truly reduplicating syllable was motivated by the assumed possibility of maintaining a more normal speech tempo in the former case.

The rhythm of natural speech is considered to be maintained in reiterant speech and to appear more naked there.

Each test sentence both in its sense and non-sense, reiterant form was recorded a minimum of eight times by the present author.

3.3 Results

As noted above I assume that the temporal relations of successive syllables among other things reflect the speech rhythm. Measurements of segment durations were made on the reiterant versions only.

In the following I will concentrate on the temporal relations among unstressed syllables.

Figure 1 compares the temporal relations of consecutive syllables in test sentences 1-3 (means of 5-9 repetitions).

It should be noted that the use of alternating ba- and da-syllables creates a bias so that every odd syllable (ba) in Figure 1 has an absolute duration which is slightly overestimated and every even syllable (da) has a slightly underestimated duration. This is due to the inherently longer occlusion of b than of d. The size of this inherent difference is minute, however, approximately on the order of 10-15 ms (cf. Löfqvist 1976, p. 5).

If we take this small bias into consideration, we get the following picture.

The rhythmic alternation among unstressed syllables is reflected in the temporal domain as an alternation in syllable duration. This alternation between shorter and longer syllables can be seen as a reflex of the postulated rhythmic alternation between weak and strong syllables (see the preceding section). The temporal relations displayed here also seem to be in accord with the hypothesis that the alternation between weak and strong syllables is governed from the upcoming stress, so that the pre-stress syllable is relatively shorter, the preceding one is relatively longer and so on by way of alternation.

Looking at the two unstressed syllables following the first stressed syllable, we find a very similar pattern for sentences (1) and (3), those with an odd number of syllables

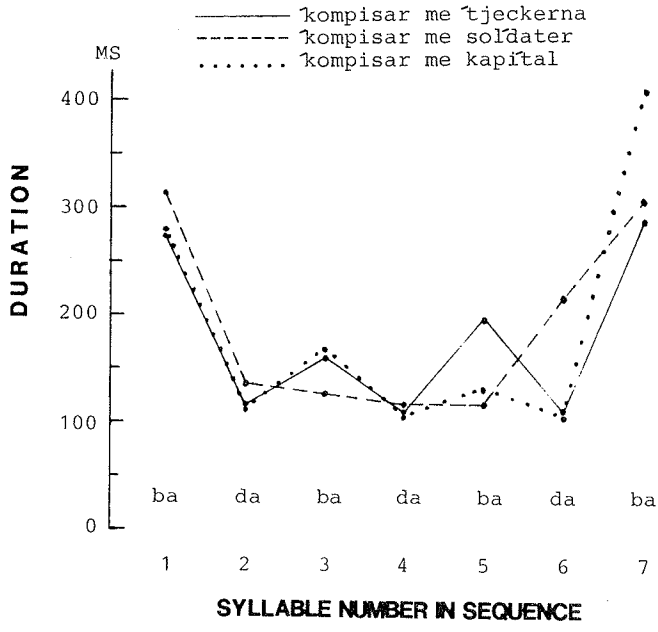

Figure 1. Rhythmic alternation. Durations of consecutive syllables in the reiterant versions of test sentences 1-3 (means of 5-9 repetitions).

between the stresses: the first unstressed syllable corresponding to pi is clearly shorter than the second unstressed syllable corresponding to sar reflecting the alternation. For sentence (2) with an even number of syllables between the stresses the situation is reversed; the first unstressed syllable pi is longer than the second one sar. This is exactly what is predicted by the above hypothesis. An uneven number of syllables between the stresses fits neatly into an alternating pattern from the point of view of both stresses, while an even number of syllables between the stresses necessitates a rhythmical resetting, which appears to be governed from the second of the two stresses.

If we look at the temporal pattern of the whole succession of unstressed syllables, four in sentence (2) and five in sentence (3), we observe that the alternation is not phonetically uniform. The first, strong unstressed syllable after the first of the two stresses is clearly longer than the second, strong

unstressed syllable, while the difference between the corresponding weak unstressed syllables is very small.

Figure 2 shows the temporal relations for the whole test material displayed in a different way. The values are means of 5-9 repetitions.

Looking at test sentences 4-6 the alternating temporal pattern recurs for the unstressed syllables between the stresses. In sentences (4) and (5) with four and three unstressed syllables respectively between the stresses the same proportions hold as for a comparison between sentences (2) and (1) also containing four and three unstressed syllables respectively between the stresses.

It is notable that in sentence (6) with two unstressed syllables between the stresses the same relation holds as for the corresponding, last syllables in sentences (2) and (4) having four unstressed syllables between the stresses. My interpretation of this is that even with two unstressed syllables between the stresses, these two syllables are not equally prominent but have a strong to weak relationship. This is in agreement with the hypothesis that the alternation is governed from the following stressed syllable.

Looking also at the unstressed syllables in initial and final position (before and after the stresses) we find reflexes in the temporal pattern of the postulated strong-weak alternation.

In reasoning so far about rhythmic alternation I have been regarding the CV-syllable as a unit. If instead we look at C and V separately, it appears that the rhythmic alternation is reflected in both C's and V's duration. Judging from the present pilot experiment the relative difference in duration of a weak C compared with a strong C is greater than a corresponding comparison between a weak and a strong V. It is therefore a possible hypothesis for further experimentation that C's strength expressed in relative duration is as important as (more important than?) V' strength expressed correspondingly.

Finally it is worth noting that no tendency towards isochrony between the stressed syllables is apparent from the present investigation.

Figure 2. Rhythmic alternation. Durations in ms of consecutive segments in the reiterant versions of the test sentences (means of 5-9 repetitions).

4. DISCUSSION

In this paper I have tried to demonstrate that besides the alternation between stressed and unstressed syllables in Swedish utterances there is normally also an alternation among the unstressed syllables described as strong and weak, which is not so widely recognized. See, however, suggestions of a similar kind for English by Giegerich (1978, 1980), and also for Swedish by Strangert (1981). I suggest that this division into groups and subgroups of syllables in terms of prominence relations is an important aspect of speech rhythm in Swedish.

I have argued that the simplest kind of weak-strong alternation among unstressed syllables is related to the actual stressed syllables so that the syllable adjacent to a stress is weak, the next one strong and so on by way of alternation. An even number of unstressed syllables between two stresses creates a conflict, however. In this situation the alternation appears to be governed from the second of the two stresses, thereby introducing a rhythmical resetting after the first of the two stresses.

This suggests the existence of a pre-planning device or look-ahead several syllables in advance. In fact, the plan for the rhythmic alternation up to the next stressed syllable must exist at the point in time where a stressed syllable is being executed.

It is reasonable to ask why in situations of rhythmical conflict there should be an adaptation to the following and not to the preceding stress.

One way of answering this question is to ask, if a sequence, for example, of four syllables between two stresses realized as weak-strong-weak-strong, i.e. adapted to the preceding stress, would be impossible. The probable answer is that such a rhythmical sequence would be perceived as having yet another stress on the syllable preceding the final stress, as in kómpisar me två tjécker ' friends with two Czechs'. The same sequence realized as strong-weak-strong-weak between the stresses has no such implication, although the first strong in this sequence may coincide with a lexical secondary stress of a compound as in útbildningen på sőder 'the education on the

south side' comparable to kőmpisar me soldáter. That this lexical secondary stress is not necessarily rhythmically strong is evidenced by the fact that it may be subject to rhythmic alternation in útbildning på tőmbola ' education on the tombola' corresponding to kőmpisar me tjéckerna.

It is possible, however, that a motivation for the observed rhythmical asymmetry can be formulated in more general, psychological terms.

I have found it possible to account for rhythmic alternation among unstressed syllables in Swedish, i.e. rhythm at a micro level, without recourse to metrical constituent structure. In an extended study of speech rhythm including also rhythm at a macro level the relation between underlying metrical patterns and the rhythmical structure of an utterance has to be taken into consideration.

A problematic issue is the division of consecutive syllables into stress groups and rhythmical subgroups within stress groups. The principle of rhythmic alternation suggested above can be interpreted as counterevidence against the traditional division into stress groups, where a stress group is said to contain the stressed syllable and consecutive unstressed syllables up to the next stressed syllable or to the end of the speech unit. The implication of the principle of rhythmic alternation, which shows a right-to-left planning for the unstressed syllables between two stresses, is to put the stress group boundary immediately after a stressed syllable. Thus a stress group would instead in most cases begin with unstressed syllables and end with a stressed syllable. Also among the unstressed syllables there is a corresponding problem of division into rhythmical subgroups.

Related to the issue of division into rhythmical groups is the question of the strong-weak relationship. It is assumed that in the case of rhythmic alternation, as it has been described here, strong-weak is a local relation between two consecutive syllables, i.e. a certain syllable is strong or weak only in relation to its closest neighbouring syllable. This means in phonetic terms that a certain weak syllable can be physically longer than or as long as a strong syllable in the same sequence

of syllables, provided it is shorter than its strong pair mate.

In this paper I have looked for reflexes of rhythmic alternation mainly in the relative durations of successive syllables. I have also suggested that the length contribution to the rhythmical signalling may not be evenly distributed over a syllable but may be confined to a certain portion of the syllable, for example the C preceding the vowel (syllable onset) or to a portion across the CV-boundary. This proposed difference in the distribution of rhythmical signalling seems to reflect the two different conceptions of temporal events, such as rhythm, as durations (additive) versus temporal points (divisive) discussed in Liberman (1975, pp. 271 ff.).

Although I have been looking here for reflexes of rhythmic alternation exclusively in the time dimension, this does not mean that I conceive of rhythm merely as a length phenomenon. It is clear that the kind of rhythmic alternation found for example in situations of clash of stress may involve alternation of pitch. In cases of three consecutive stresses it is my impression that the weakening of the middle stress is expressed phonetically not primarily by reduced relative length but by the absence of pitch correlates characteristic of the surrounding stresses.

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