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progredientes Intonationsmuster neutralisiert. Sie werden auch bei Akzentsenkung, wie Vergleichsuntersuchungen mit vokalischen und konsonantischen Oppositionen zeigen, nicht leichter neutralisiert als segmentelle Phoneme. Tonakzente verhalten sich also nicht anders als die übrigen distinktiven Mittel einer Sprache.

Zusammenfassend läßt sich feststellen, daß das „linguistische Problem" der Suprasegmentaliaforschung kein Problem der linguistischen Analyse und Beschreibung, sondern ein Problem der validen Identifizierung ist. Eine valide Identifizierung kann aber nicht von den phonetischen Merkmalen, sondern nur von der Feststellung der sprachlichen Funktionen her erfolgen.

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The Relation of Sentence Modality and Word Accent in Certain Intonation Contours

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One of the linguistic functions of intonation is to monitor the sentence modality as terminal, progredient or interrogative. Another function of intonation is to accent certain parts of words or sentences. The aim of the present study was to investigate the relation between those means of intonation which are used as markers of sentence modality and those which function as indicators of word stress in sentence final position. Such cases occur when words with distinctive word stress appear in sentence final position.

The following 16 German sentences were used for the study:

1. *Das wird MOdern!*
2. *Das wird MOdern?*

9. *Sie wollten das Hindernis UMfahren!*
10. *Sie wollten das Hindernis UMfahren?*

3. *Das wird moDERN!*   11. *Sie wollten das Hindernis umFAHren!*
4. *Das wird moDERN?*   12. *Sie wollten das Hindernis umFAHren?*
5. *Sie erkennen den TENor!*   13. *Sie können Übersetzen!*
6. *Sie erkennen den TEnor?*   14. *Sie können Übersetzen?*
7. *Sie erkennen den TeNOR!*   15. *Sie können überSETzen!*
8. *Sie erkennen den TeNOR?*   16. *Sie können überSETzen?*

In each set of four sentences, contrasts of distinctive word accent and sentence modality are combined. These sentences were produced four times by two speakers of Standard German on different days. By means of a computer program for signal processing (ILS-STI) the material was acoustically analyzed. This led to an extraction of the fundamental frequencies (Fo), intensities and durations. The standard contours of the Fo-variations derived from the means of productions of both speakers were stylized into abstract contours (see Rossi 1971).
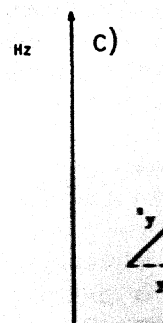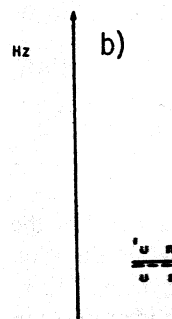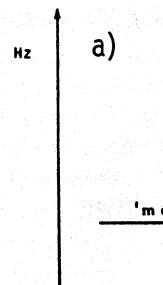
Results from acoustic analyses

The acoustic analysis for the declarative sentences confirms the general view held by a number of linguists that the accentuation of a syllable is clearly manifested in the relative height of the Fo-contour. At the time, the sentence modality is indicated by the fall of the Fo-contour in the final syllable. The simultaneous indications of modality and word accent in the sentence final word do not interfere. For interrogative sentences, however, word accent in sentence final words cannot be differentiated by the Fo-contour of the stressed syllable. Here, the stressed vs. unstressed contrast is indicated by the onset time of the Fo-rise (in expressing the sentence modality question). The beginning of the rise is accompanied by a maximum of intensity; but it should be noted that the differences of intensity between the stressed and unstressed syllables are only small. For two-syllable words, the stressed vs. unstressed contrast is accompanied by a marked difference in duration between the stressed and unstressed syllables. Figure 1 a—c shows the schematized Fo-contours including the duration parameter of the words *modern, umfahren* and *übersetzen*, in interrogative form.

A perception experiment

Since the experimental acoustic data allow only for a limited insight into the relevance of the parameters for listeners, a perception experiment was carried out. The patterns of Fo, intensity and duration of the respective pairs of words were interchanged. Only the interrogative forms were considered, since the acoustic analysis of the declarative sentences showed that the relative height of the Fo-contours consistently varied with the linguistic functions.

By means of a graphic computer program for the interactive manipulation of signal parameters the analyzed parameters of the words were reconstructed according to the pattern of the respective contrasting partner. Thus, for each pair of words eight different versions ensued. For example, the interchange of Fo-contours of the words *MOdern/ moDERN* was carried out in such a way that the beginning of the Fo-rise within the second syllable was shifted from an early to a late point of rising, and vice versa. In manipulating the factor duration of syllable in the three- and four-syllable words the fact had to be accounted for that the acoustical analyses had revealed no

a)

Hz

d ɛʊn

'm o
mo

'dɛʊn

sek

b)

Hz

ʊ ə n

fa

'ʊən

'u m
u m

''fa

sek

c)

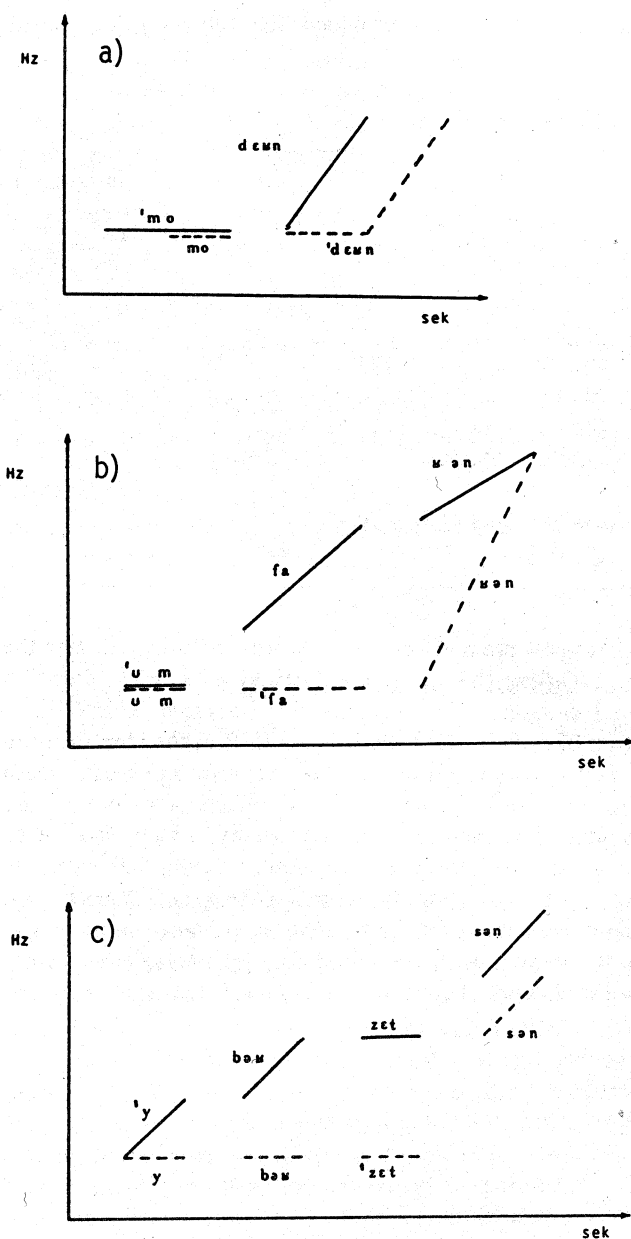Hz

sən

zɛt

'sən

bɔʊ

'y

y   'bɔʊ   'zɛt

sek

Fig. 1a—c: Schematized Fo-contours of the words *modern, umfahren* and *übersetzen* in interrogative form

differences in duration for the respective pairs. In order to investigate a possible influence of this factor also for these stimuli, the duration of syllables in question was modified by the factor 2 and 1/2, respectively. Thus, a $2 \times 2 \times 2$ design for an analysis of variance ensued with the factors duration of syllable (long/short), location of the maximum intensity (front/back) and onset of the Fo-rise (early/late). The manipulated and re-synthesized stimuli were presented to 21 subjects in randomized order for a categorical identification task via loudspeaker in a sound-treated booth.

An analysis of variance of the perception data provided the following significant results:

Tab. 1: F-values of the significant effects, p < .001

	main effects			2 × interaction			3 × interaction d-Fo-i
	duration //	Fo //	int ///	d-Fo //	d-i //	Fo-i ///	
MOdern	1516.03	93.03	98.46	27.30			
moDERN	847.78	119.45	221.32	157.34	183.		
TEnor	2355.21		73.76				
teNOR	433.46	222.31	106.74	44.12	50.21		
UMfah	1327.74	955.6	50.71	759.14		54.49	
umFAH	1318.87	35.36					
Überse	220.33	117.36	56.23	44.82	78.		
überSE	268.88	110.99	121.08				

The factor duration shows the strongest main effect for all words investigated. For the three stimuli *umFAHren, TEnor, MOdern*, the mere modification of syllable duration effected a change in the perceived category. For the stimuli *Übersetzen, überSETzen, TeNOR, moDERN*, the modification of syllable duration led to a shift in the identification to change judgements. For the factor onset time of Fo-rise also significant main effects could be found, except for the word *TEnor*. But these effects were not strong enough to evoke a categorical change. The modification of intensity, which also led to significant effects except for the word *umFAHren*, led to similar perceptual shifts as the variation of the onset time of the Fo-rise. For the stimuli *Übersetzen, überSETzen, TeNOR, moDERN* none of the significant main effects resulted in a change of category. Beside the main effects, significant interactions were found for the two-syllable words *moDERN* and *TeNOR* between the factors duration and onset time of Fo-rise
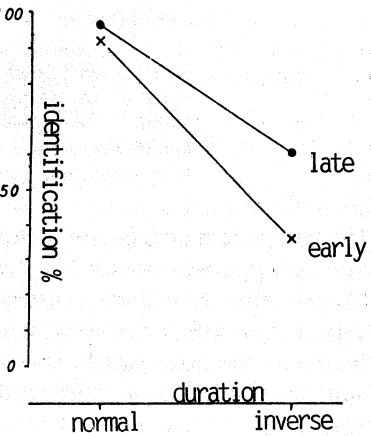

Fig. 2: Interaction between the factors *duration — onset time of Fo-rise* for the word *modern*

and duration and location of maximum intensity, respectively. Both led to a change in the perceived position of stress. Figure 2 illustrates for the word *modern* that the modification of the onset time of the Fo-rise has only very little effect, if the syllable durations remain unchanged; if, however, the durations of the syllables were interchanged, the modification of the onset time of the Fo-rise effected the perception in such a way that listeners perceived the first syllable of the word as bearing stress. In four-syllable words also an interaction of the factors in question could not change the perceived stress position. This may be explained by the fact that the two potentially stressed syllables are separated by an unstressed syllable and that they are followed by another unstressed syllable. Thus, a conflict arising from the simultaneous realization of sentence modality and word accent does not exist to the same extent as for two- and three-syllable words.

The findings from this study question the assumption held by a number of linguists that the Fo-contour is the primary parameter indicating stress.

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Preferred Syllable Structure as a Determinant of Noun Pluralization in the Germanic Languages

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This study is concerned with certain connections between morphology and syllable structure. Specifically, we will demonstrate how Vennemann's recently proposed theory of universal preference laws for syllable structure can elucidate certain regularities involving inflections — especially noun plurals — in the modern Germanic languages. Phonology and morphology can often work at cross purposes with one another, leading to conflicts between morphological naturalness on the one hand and phonological naturalness on the other. In particular, structures may result which are quite good morphologically speaking but rather poor in terms of syllable optimality, or vice-versa. Therefore, there may be reactions to eliminate the worst violations of the relevant universal preference laws, thereby yielding improved syllable structure on the given parameter. Alternatively, the resources of the morphological system may allow for alternatives which better accommodate preferred syllable structure. These results can then be seen in patterns of the synchronic system, for instance in terms of morpheme choice or the phonological adaptations which accompany affixational processes. A number of such cases concerning inflectional suffixes in the modern Germanic languages will be cited here, and it will be argued that Vennemann's proposals reveal the syllabic motivation behind the regularities discovered by showing them to be instantiations of universal preference laws for syllable structure.

In recent work Vennemann has proposed a series of universal preference laws, which "specify the preferred syllable patterns of natural language". For details of the theory, cf.

Vennemann (1983, 1986, to appear) and Shannon (1986, to appear) for application of it. These naturalness conditions are stated as gradient universal preference laws, which "have their basis in the human productive and perceptive phonetic endowment", and refer crucially to Universal Consonantal Strength (CS). The resulting CS Hierarchy ranks stops, fricatives, nasals, laterals, central liquids, glides, high, mid, and finally low vowels in that order. Although the effects of the preference laws are often seen most clearly in diachronic comparisons (sound changes), we will be concerned here with evidence from the synchronic inflectional systems in the Germanic languages, particularly noun plurals, which largely adhere to the Synchronic Maxim: "A language system will in general not contain a structure on a given parameter without containing those structures con-structable with the means of the system that are more preferred in terms of the relevant preference law." In the following the relevance of several of these preference laws in the Germanic languages will be demonstrated.

The first preference law to be considered is the Shell Law, which states "In general, a shell [=syllable — nucleus, TFS] seems to be the more preferred, the less similar are the head [=what precedes the nucleus, TFS] and the (mirror image of the) coda. In particular, identical speech sounds flanking the nucleus are disfavored, and the more so the lesser is their CS [, the more unstressed the syllable is, and the more reduced the nucleus is, TFS]." Elsewhere (Shannon 1986, ms.) I have been able to show that this law is clearly at work in Dutch, where shells of the type /rər/ are systematically avoided by various means. Moreover, the Shell Law appears to be at work elsewhere in the modern Germanic languages. Thus, in Danish (Diderichsen 1972) "most substantives form their plural in -(e)r ... Substantives of one syllable form their plural in -e when they end in -r ...". Note, however, that this restriction is not exceptionless in Scandinavia, for I believe that otherwise such plurals are allowed. Similarly in German and Yiddish nouns ending in /r/ apparently never pluralize with the -er suffix but rather with other suffixes such as -e or -en. Finally, in Dutch nouns feminine nouns ending in -se take the plural suffix -n instead of the otherwise regular -s. In all these cases the Shell Law provides the syllabic motivation for the observed distribution of plural suffixes, since poor shells of the form /rər/ and /səs/, which are disfavored by the Shell Law, are avoided and more preferred forms result.

The Shell Law appears to be perhaps only a local, intersyllabic instantiation of a much more general principle governing sequences of segments, syllables, morphs, etc., called (cf. Shannon 1986) the (Syllable) Sequence Law (SSL): "A sequence of (unstressed) syllables is the more preferred a) the fewer the number of (successive) unstressed syllables it contains, b) the less alike the sounds involved are, and c) the stronger the sounds involved are." In the Germanic languages there is a clear tendency to conform to this law in that sequences of unstressed syllables are often avoided in inflection, especially if segments which are weak in terms of CS (viz. sonorants) are involved. Thus, Afrikaans, Frisian, and Dutch all have two main plural markers: -e/-(e)n versus -s, and in all three languages there is a clear preference for -e/-(e)n as the plural morpheme after stressed syllables and -s after unstressed ones. Moreover, with Dutch adjectives there is a certain tendency to otherwise conform to the SSL. These tendencies are readily under-standable in terms of the SSL. After unstressed syllables the addition of -e(n) would produce a sequence of unstressed syllables, which is disfavored by the SSL. The suffix -s, on the other hand, does not create another unstressed syllable and thus avoids the undesired sequence. Furthermore, the SSL claims that sequences of unstressed syllables