

A NOTE ON THE ROLE OF PITCH AS AN ELEMENT OF THE ACCENT WITHIN SYNTHETIC PAIRS OF SYLLABLES

CHRISTOPH GUTKNECHT*

0. INTRODUCTION

The problem of the relative importance of the parameters of intensity, fundamental frequency and duration in the perception of stress has been studied in a series of experiments with regard to several languages, including English (Fry, 1955, 1958, Bolinger, 1958, Morton and Jassem, 1965), French (Rigault, 1962), southern Swedish (Westin, Buddenhagen, and Obrecht, 1966), Serbo-Croatian (Rehder, 1968), and Polish (Jassem, Morton, and Steffen-Batóg, 1968). Experiments with the perception of linguistic stress by German listeners remained to be done.

1. PROBLEM

The present paper is concerned with the results of an experiment carried out with 30 German listeners in which the attempt was being made, with the exception of the parameters time and intensity, to investigate the role of pitch in the perception of accent within pairs of syllables.

2. PURPOSE AND PROCEDURE

Wiktór Jassem and his two co-authors recently emphasized that "it has long been recognized that synthetic speech is the best material for testing the relevance of acoustic parameters of a linguistic signal at the level of perception" (Jassem *et al.* 1968:295). Although this is not beyond all doubt the author of the present paper followed Jassem in using speech-like stimuli of the 'nonsense' type instead of synthesized versions of actual, semantically valid linguistic material.

The 'word' elements under consideration — [sɔsɔ - sasa - sisi] — were produced on a formant-coded speech synthesizer (Parametric Electronic Vocal Analogue of

the type EVA MARK III, Melpar Inc.) belonging to the Department of Phonetics at the University of Hamburg. The steady-state part of the vowels is analogous for all three stimuli, the same time-analogy holds for the transitional phases: variations thus arise only through the different positions of the formants.

The general framework of the experimental analysis here reported was quite simple.

The 30 listeners, students in the Fachbereich Sprachwissenschaften of the University of Hamburg, required no explanation as to what they were expected to mark on their questionnaires (with a time-limit of 15 seconds) apart from a simple request to decide whether they felt the first or the second syllable of the pairs was stressed, or to make a no-preference judgment if they thought the two syllables to be of equal stress. However, the listeners had no extensive phonetic training and their general knowledge of phonetics is so limited that they may be described as 'naive'.

The test was run in an 'Electron' language laboratory, between two and five listeners taking part at a time. The tapes were reproduced over a high quality loud-speaker at medium speed. The entire material of 75 items (i.e. 25 incremental pitch variations with step-ups and step-downs of 20 Hz within the range of 180-100 Hz) was presented in random order at one session. The order of presentation was [sɔsɔ - sasa - sisi].

3. RESULTS

	Hz.	Stimuli	[sɔ-sɔ] Stress			[sa-sa] Stress			[si-si] Stress				
			FS	SS	NP	FS	SS	NP	FS	SS	NP		
			(N/Stud)			(N/Stud)			(N/Stud)				
(a)	1	180/180	1	—	3	2	25	3	—	27	3	—	27
	2	180/160	4	—	19	7	4	18	8	4	18	6	6
	3	180/140	7	—	18	9	3	19	10	1	18	11	1
(b)	4	180/120	10	—	15	13	2	16	12	2	17	13	—
	5	180/100	13	—	14	15	1	15	15	—	16	14	—
(c)	6	160/180	16	—	3	27	—	2	28	—	3	26	1
(a)	7	160/160	19	—	2	3	25	2	—	28	3	—	27
	8	160/140	22	—	18	7	5	19	8	3	18	8	4
	9	160/120	25	—	20	8	2	21	7	2	24	5	1
(b)	10	160/100	28	—	13	15	2	16	14	—	16	14	—
(c)	11	140/180	31	—	3	27	—	3	24	3	4	26	—
(c)	12	140/160	34	—	5	25	—	2	25	3	3	27	—
(a)	13	140/140	37	—	—	3	27	3	—	27	3	2	25
	14	140/120	40	—	17	7	6	18	8	4	17	8	5
	15	140/100	43	—	20	7	3	21	9	—	20	6	4
(c)	16	120/180	46	—	3	27	—	2	28	—	3	27	—
(c)	17	120/160	49	—	4	25	1	6	22	2	3	24	3
(c)	18	120/140	52	—	2	25	3	5	25	—	3	26	1
(a)	19	120/120	55	—	—	3	27	3	—	27	1	2	27
	20	120/100	58	—	16	8	6	18	9	3	17	8	5

* Read by Jens-Peter Köster.

	Hz.	Stimuli	[sɔ-sɔ] Stress			[sa-sa] Stress			[si-si] Stress		
			FS	SS	NP	FS	SS	NP	FS	SS	NP
			(N/Stud)			(N/Stud)			(N/Stud)		
(c)	21	100/180	61	-63	1 29 —	2 28 —	2 28 —	2 28 —	2 28 —	2 28 —	2 28 —
(c)	22	100/160	64	-66	— 30 —	3 27 —	3 27 —	— 30 —	— 30 —	— 30 —	— 30 —
(c)	23	100/140	67	-69	— 28 2	2 26 2	2 26 2	— 30 —	— 30 —	— 30 —	— 30 —
(c)	24	100/120	70	-72	3 23 4	2 24 4	2 24 4	— 25 5	— 25 5	— 25 5	— 25 5
(a)	25	100/100	73	-75	— — 30	1 1 28	1 1 28	1 1 28	1 1 28	1 1 28	1 1 28

Abbreviations: FS = First Syllable, SS = Second Syllable,
NP = No-Preference Vote, N/Stud = Number of Students.

4. DISCUSSION OF RESULTS

(a) It is of note that for pairs of syllables with an equal level of fundamental frequency a vote of no-preference was cast almost consistently. This is the more surprising because the morphological structure of the German language demands the accent on the first syllable of most of its lexemes. Therefore, with pairs of syllables with the same level of fundamental frequency it was to be expected that, through the interference of linguistic experience, the first syllable would have been felt as accented by German listeners.

On the other hand, the above-mentioned stimuli appeared in the experiment along with patterns with relatively wide spans of fundamental frequency so that the effect of the conjunction may have induced the impression of equal stress.

(b) Even though, as a rule, the syllable with a higher fundamental frequency is classified as accented, this system of classification nevertheless clearly depends on the extent of the difference in fundamental frequency between each two syllables.

It can be seen above that where there was a span of more than 40 Hz a general hesitancy set in as to the marking of the accented syllable so that the rule that the higher syllable conveys the impression of being accented no longer applies.

(c) A further regularity is found in cases in which the frequency is higher in the second syllable. Here, with very few exceptions, the accent was placed on the second syllable. On the other hand, this consistency was not apparent when the fundamental frequency was higher in the first syllable.

IT FOLLOWS THAT the efficiency of intonation as a decisive factor for distinguishing the accentedness and unaccentedness of syllables in pairs is clearly greater for the second syllable than for the first. This may be influenced to some extent by the fact that the German listener does not normally, on account of his linguistic experience, expect the second syllable (within words of two syllables) to bear the accent and reacts more sensitively to the appearance of accent-bearing parameters.

When the different stimuli are compared with each other no regularities specific to the three 'quasi words' are discovered.

This experiment is part of a more extensive research into intensity and duration as cues to stressedness in correlation with fundamental frequency with the aim of determining the function of all parameters constituting the accent within 'words' of two syllables presented to German speaking listeners.

*Seminar für Englische Sprache und Kultur
Universität Hamburg*

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DISCUSSION

KORNFELD (Cambridge, Mass.)

I have found, in a recent study, that primary stress in English is perceived when there is a drop in fundamental frequency in the following stressed syllable. This result confirms the results of an earlier study by S. Cushing (M.I.T., 1969). My own results were based on data from a real-time display of F_0 , using a pitch-detector developed by Gold (Lincoln Labs); whereas Cushing's data were obtained by tracing the fifth harmonic on narrow-band spectrograms.

KÖSTER (answering for Gutknecht)

Thank you very much for your very interesting comment and additional information

which, I am sure, will be greatly appreciated by the author. As your commentary doesn't include questions, I would like to go on to the next question.

VANDERSLICE (New York)

Would you elaborate on the conditions under which the higher syllable was not heard as the accented one? Could this be accounted for under the rubric of Bolinger's downward-obtruded 'accent C'?

KÖSTER

The expected result was that the syllable with higher fundamental frequency is normally perceived as bearing the accent. This rule, however, has very well defined exceptions which because of their regularity are very important for the systemization of the contribution of pitch variations as an accent-bearing element. There is, for instance, the fact that the general law of according stress to the syllable with the higher frequency clearly depends on the frequency levels applied. This again is of greater importance for the first syllable than for the second, for in the second syllable the general rule just mentioned can be applied with fewer exceptions. The role of intonation for the realization of accent in German words of two syllables has thus to be defined separately for the first and the second syllable.