LUND UNIVERSITY
DEPARTMENT OF LINGUISTICS
General Linguistics
Phonetics

WORKING PAPERS

21 • 1981

FOR KERSTIN HADDING

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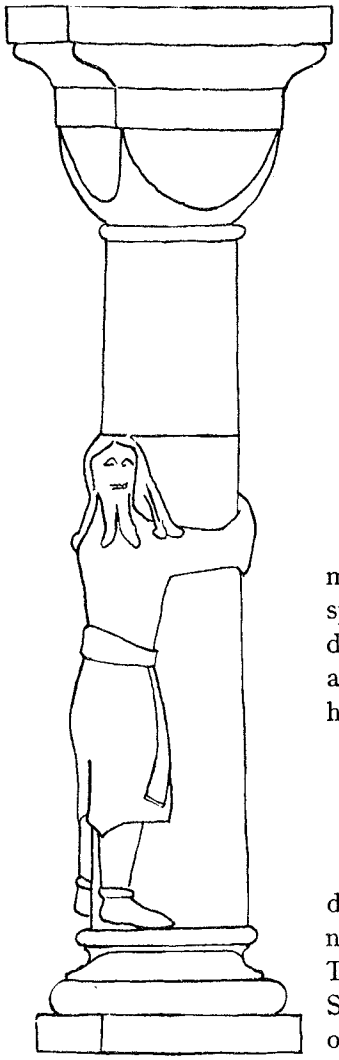

Helgona-backen

På Helgonabacken vid Lund, där nu
mamsell och fru
spatsera i doftande lunder,
där bodde det fordom en kämpe så gram,
av trollens stam,
han hade sin kula därunder.

Han ryster och ryster. Då nickar till fall
den byggnad all,
när styrkan med ens honom felar.
Till sten blir Finn, får ej liv igen.
Så står han än
och famnar sin väldige pelar.

FOREWORD

Working Papers 21 from the phonetics section of the linguistics department of Lund University honours KERSTIN HADDING, the founder of the series.
In her last seminar as an active professor, in December 1979, she talked about her life as a phonetician. She has been persuaded to make a written version of this talk, which appears as the first paper.

The rest of the contributions reflect our recent and present research activities. The papers on prosody by Bredvad-Jensen, Bruce, Gårding & Bruce, Bruce & Willstedt, and Prohovnik, were presented at the Second Conference on the Prosody of Nordic Languages in Trondheim, June 1980. Some of them are off-shoots of the project Swedish Prosody.

Kerstin Nauclér and Ewa Söderpalm read their paper on 'slips' at the Montreal Congress of Applied Linguistics.

Gårding's *Optimal Teaching of Swedish Pronunciation* and Bannert & Hyltenstam's *Problems of Understanding and Being Understood* are connected with project work on foreign accents in Swedish. The optimization project has now been completed. The results were published in numbers 1, 3 and 5 of *Praktisk Lingvistik*, available through our department.

There are two new contributors, Antonis Botinis and Lea-Liisa Lahti. Their papers are results of a much appreciated course, *The nature of features*, given by Mona Lindau-Webb during the fall semester.

I conclude this foreword by summarizing the main events since the beginning of 1980.

Bengt Mandersson has joined our staff. He is a telecommunications engineer and is now developing new programs and methods for speech synthesis.

Two PhD theses have been defended, *Perspectives on Misspellings* by Kerstin Nauclér and *Some Swedish Sibilants* by Per Lindblad. Claes Christian Elert and Sven Öhman were the opponents. The dissertations appear as numbers XV and XVI of *Travaux de*

l'Institut de Linguistique de Lund.

Two symposia were held at our department. The 7th Swedish Danish symposium for graduate students, June 1980, was organized by Gösta Bruce. The second was arranged by Bengt Sigurd to inaugurate our new building and in connection with my installation. It took the form of a panel debate on the theme: "How far can the speech sciences reach?" David Ingvar, Mona Lindau-Webb, Ulrika Nettelbladt, Nina Thorsen and Sven Öhman were on the panel, chaired by Sigurd.

Gösta Bruce arranged and led an all-Swedish Conference on prosody at the Royal Institute of Technology in Stockholm in January 1981.

On the undergraduate level about 115 students will have completed the first and second-term courses by the end of the spring term from 1980.
There are at present 15 third-term students and 10 graduate students.

Apart from the regular courses at the undergraduate level two graduate courses were given, one on prosody in the fall of 1980 by myself and one on perception in the spring of 1981 by Anders Löfqvist.
In addition to two longer stays by Mona Lindau-Webb we have enjoyed visits and talks from

1980	Linda Waugh Ithaca	The multifunctionality of speech sounds
	Mats Hedelin Göteborg	Hur ser datorn på tal?
	Ragnhild Söderbergh Stockholm	Modell för analys av interaktionen barn-vuxen
	George Allen Colorado	The development of rhythm in children's speech
	Henning Wode Kiel	An integrated view of language acquisition: L1, L2, L3 ....
	Iván Fónogy Paris	Prosodic expression of emotions
		Comparative studies of prosody: French, Portuguese, Hungarian etc.
	Laura Dascălu Bukarest	Question intonation in Rumanian
1981	Peter Wittenberg Nijmegen	Informal seminar

Peter Ladefoged Los Angeles	On divorcing phonetics from phonology
Lori Taft Amherst	Informal seminar
Roger Lass Edinburgh	R-sounds in modern and old Germanic
	The status of historical linguistics
Hiroya Fujisaki Tokyo	Informal seminar
Alan Bell Colorado	Isochronic Perception
Eli Fischer-Jørgensen Copenhagen	50 år med fonetik och fonetiker
Ilona Kassai Budapest	Acquisition of prosody in Hungarian

The Humanistic and Social Sciences Research Council, group 9, Linguistics, visited us in March. Projects supported by the Council reported on their progress in a seminar led by Jan Svartvik.

Antti Iivonen and a group of speech pathologists and phoneticians from Helsinki came to see us in April. We had a joint seminar with summaries and discussion of our research activities.

We have continued a long-standing tradition of meeting with our colleagues from the phonetics department in Copenhagen. We were in Copenhagen when Paul Kiparsky visited them, and Eli Fischer-Jørgensen, Jørgen Rischel and Nina and Oluf Thorsen came to Lund for a seminar about methodological problems.

One final note: our laboratory has moved from one historic part of Lund to another. Our former site at Kävlingevägen was part of the fields where the Danes fought with the Swedes to win back Skåne, which had been lost by the peace treaty of 1658. The present location on Helgonabacken was once the abode of the famous wicked giant, Finn. His raid against the church and his subsequent petrification are described in a poem by Esaias Tegnér (1829), see the frontispiece. The drawing is by Oscar Reutersvärd.

Lund, May 1981

Eva Gårding

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This issue has been edited by Eva Gårding and Sidney Wood

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PHONETICS AND I 1952 - 1979

Kerstin Hadding

I first met Phonetics in the shape of Kenneth Pike, in 1952. But first a few words about what had gone before.

Between 1940 and 1952, after my M.A. in 1940, I had been at home, taking care of four children and had for various reasons, not continued studies or held any outside jobs. Now and then I had done translation work, mainly Swedish medical dissertations.

In the autumn of 1952, I accompanied my husband to Rochester in Minnesota, where he was to study surgery at the Mayo Clinic. After a few weeks I felt that I had had enough of my nice, comfortable life there, with nothing to do but shopping, lunching, cocktailing etc. I also felt very much of a stranger, somehow, and outside of everything around me. So I went away, fled rather, to the University of Minnesota, Ann Arbor, and enrolled as a graduate student there. Although I was at least ten years older than anybody else in the group, it was great fun, and my fellow students were extremely nice and helpful to me. I went to Ann Arbor because I had brought with me a letter of recommendation from Professor Arngart in Lund (whose "licentiat" seminars I had just then started to follow) to Professor Marckwardt in Ann Arbor, who greeted me kindly and also became my supervisor. My idea was actually to study English, or rather to try to find out as much as possible during one term about what had happened to the various British dialects on American soil. With this in mind I also enrolled for Professor Kurath's seminars on Dialectal Geography.

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1) This is, as you will see, not the history of phonetics between 1952 and 1979 but rather a personal and rough outline of my own most immediate contacts and experiences within the phonetic field.

Very soon, however, I met other graduate students who strongly advised me to take the opportunity to listen to Professor Pike's lectures. They told me that he was talking about some new (to me at least) things called phonemes, morphemes, and linguistic structure, and in a very interesting way. That he was quite famous, in fact. I followed their advice and went to see Kenneth Pike. The man seemed a fireworks of ideas, questions, gestures - he kept rushing his chair from one part of the room to another, talking all the time and firing questions at me. In half an hour he had grasped the Swedish phonemic system (a system that I, of course, at that time did not know existed), and seemed to have got a good grasp of the word accents, or tones, i.e. my South Swedish version. He told me, among others, that Sweden was "a black spot" on the map as far as modern linguistics was concerned - even in the darkest part of Africa one knew more. I would in fact do a good deed if I went back and spread the light. I might as well concentrate on intonation patterns of Swedish, particularly sentence intonation versus word tones. There was one person in Sweden, however, who seemed to have grasped what structural linguistics was about - his name, said Pike, was Malmberg, Bertil Malmberg.

I felt almost stunned after this meeting but also excited. Moreover, Malmberg lived in Lund, as far as I knew, so it should not be difficult to get in touch with him. How wonderful too to be one of the first in the country instead of joining the long waiting line in the English Deparment, as had been my intention. Not any longer!

Pike was actually on leave, more or less, at the time, but still had his seminars going and promised me that he would instruct one of his doctoral students to take care of me. At the end of the term he would (and also did) examine me in Phonemics and Morphemics, informally. I went back to my supervisor and told him, rather shamefacedly, that I wanted to leave his course and move over to Pike's - I did not have money enough to pay for another course - it was not cheap to study in the U.S. Marckwardt told me that he was sure that I was making a mistake but nevertheless

signed the necessary papers, saying, very generously, that I could continue his course too, without cost, so to speak. I am afraid I let him down entirely on that - Pike's courses meant a lot of hard work as they were all about things that were quite new to me.

When my tutor Helen Wang, from Singapore, seemed to me to be too hard on my rendering of foreign phonemes and tones, I asked her to say, after me *sju sköna sjömän* [ɧʉ:ˊɧø:naˋɧø:mɛn], "seven beautiful sailors". She always broke down on that and was less severe afterwards.

In Ann Arbor I also listened to Nide on Morphemics, Fries on Structural Grammar, and to Lado on Applied Linguistics. One day I was taken to a modest laboratory, headed by a man called Gordon Peterson. He wanted to show us a new machine, which, however, unfortunately was not in the mood to perform on that particular day. This was my first contact with the Sonagraph and my only one with Gordon Peterson.

Back home in Lund, I naturally looked for Bertil Malmberg, according to Pike our only modern Swedish linguist. I found then that he had become a professor in a new subject, Phonetics, in 1950. The Phonetics Department happened to be in the top part of my parents' house. He had one assistant, and their most important phonetic aid was the kymograph.

The kymograph - I have missed it many times after it was put away as too obsolete. I wonder if any other single device has provided the beginner with an introduction as clear and as pedagogical as the kymograph's about what happens in articulation. Talking with a funnel pressed against your mouth and glass sticks (so-called nose olives) stuck into your nostrils, you could see how small pieces of reed, fastened to membranes at the other end, started to move and sometimes to vibrate, drawing on a sooted piece of paper which was wrapped around a cylinder that rotated at a known rate. The difference between voiced and unvoiced sounds, between nasal and oral, aspirated and unaspirated, stops and spirants was demonstrated in a very direct manner. You could

also measure the duration of the sounds, and if you had a thing fastened to your throat you got a third, "laryngeal" curve, where you could measure the distance between the peaks of the vibrations and thus see how the pitch rose or fell.

The tricky job of coating the paper with soot by means of a Bunsen burner produced, as a byproduct, a considerable team spirit. Although we had only few and simple instruments, Phonetics was considered to be too technical for women and most of our students were men. I believe that more than one couple first found each other over the drum of the kymograph - the female voice was usually unsuited to the membranes and did not cause vibrations strong enough to show up on the paper. Male help was therefore necessary for the female students to get recordings that could be measured.

And measured they were, often by means of Meyer's Pitch Meter. This instrument measured the distance between the peaks of the vibrations of the voice fundamental in such a way that the result was an auditively correct (or so I suppose), logarithmic curve. The interest was not only in periods per second but also in notes and octaves. This, I believe, could well be taken more into account than is usually done today.
Everything was done manually and took an enormous amount of time. On the other hand each one knew every step in the process, from beginning to end. This has its advantages, no doubt about that.

One result of my studies in Ann Arbor was an examination paper in Lund 1954, called *Trends in modern American linguistics*, which was an attempt to present some main points in American structural linguistics as I had understood them. At that time the "licentiatexam" still existed. I wrote my thesis on Swedish intonation for this degree and used Pike's method of description. It is not really at all difficult to analyze and describe sentence melody by means of four or five pitch "levels" and three final junctures, or to divide an utterance into smaller units, each with one primary stress. It becomes a kind of stenography, or rather perhaps a transcription, which can be written out in

full when necessary.

In 1957 I became an assistant lecturer and started to write a dissertation for the Ph.D. Most of our students were then following our so-called propaedeutic course, which was obligatory for all language students. It comprised about 22 lectures and some hours of laboratory work. Those who went on to study the subject more extensively were at that time comparatively few. The activities within the department grew, however, and we had to move to get more space. Our new address was Kävlingevägen 20, where we were to stay until 1979. At first, the German department had the upper part of the building and Phonetics the lower, including the cellar. It seems that Phonetics, or rather the phonetics lab., has always and everwhere occupied the cellars! Some years later the German department moved out and we had the whole house to ourselves, much to our satisfaction, since the number of our students continued to grow (more of which later). For a long time there were nevertheless only Malmberg, his assistant, and myself to manage both the teaching and the laboratory. The teaching load was at times quite heavy.

In the fifties Malmberg spent some time at Haskins Laboratories, then in New York. One result of his visit was that we got our first Sonagraph. It seemed a marvellous thing, a big step forward, even though it sometimes behaved rather strangely, probably (at least partly) owing to our inept handling of it.

It should be pointed out, I think, that General Linguistics did not exist in Sweden as a separate subject or field until 1969. Until then it was, so to speak, included in Phonetics. This meant that Malmberg's students got a solid background in linguistics. I would like to emphasize too the great pleasure it was to us to have Bertil Malmberg as an inspiring teacher, encouraging supervisor, and for me personally later on also as an unfailingly loyal colleague.

In addition to the spectrum, our first sonagraph could produce two intensity curves too, with and without damping, and it could also expand the spectrum so that only a small number of harmonics

were represented on the paper, enlarged, so to speak. I consider it to be a real drawback when the instrument, as has sometimes happened, does not provide any intensity curve at all, however grossly celibrated. I have always been of the opinion that the relation between the frequency and intensity curves can give important information as to how we perceive and interpret the sound wave. An intensity curve can, moreover, indicate when the sound has reached a level of intensity too low to be perceived by the human ear thereby saving the investigator a good deal of worried measuring and analysis.

My Ph.D. dissertation, on sentence intonation, was naturally now based on spectrographic analysis (and not on Meyer's pitch meter!). The tenth harmonic (whenever possible) of the entire spoken material was measured and noted down on semilogarithmic paper. It was, however, impossible to get a perspective on all these data. My floors at home were all covered with sonagrams and papers with measurements, but however fast I crawled from one end to another I could not get a real grasp of the thing. Something radical had to be done. To that end I went up to Stockholm, to Gunnar Fant and his Speech Transmission Laboratory, to ask for help. Fant had both the Mingograph (which we so far had not) and also his 48-channel spectrograph. A female voice was something new to these instruments, so some recalibration was necessary. When this was done, the entire corpus was processed in less than one hour (with the expert help of Aage Møller) I could return home with all the data I had already got from the sonagrams but now in a compressed form and on a manageable amount of small rolls of paper. This was exactly what I needed to continue my work.

I also returned with an increased self-confidence, thanks to Fant. At that time there was a veritable gap between linguists-phoneticians and people in the technological fields. We belonged to the humanities and had as a rule practically no knowledge of technology or even of the sciences. I did not even know what questions to ask of Fant or how to state my problems in technically correct terms. But when I expressed my feeling of inadequacy to

Fant, he said: Never mind - just use your common sense and you will manage all right. I still remember my surprised, spontaneous (and silly) exclamation: May I really?
I had probably thought that technical-mathematical know-how somehow was on a higher level, unreachable for people like me and different from other mental work.

After this encouragement I even dared to go on to use speech synthesis for my dissertation. Since I was fortunate enough to get some money from an Edinburgh foundation, my synthesizing was carried out on the Parametric Artificial Talking Device (PAT) at the Phonetics Department in Edinburgh, the head of which was David Abercrombie. It was a busy place, with much activity, and an enjoyable place to work in. The laboratory chief was Peter Ladefoged, but PAT was housed in another building and serviced by a special group. The people who worked there, taught me how to mange PAT, and stood by and helped whenever necessary, were Elizabeth Uldell, Peter Strevens and, not least, James Anthony. PAT was then still at its "TEA or COFFEE" stage, that is to say, it was a much simpler device than later on. There were six parameters in all, one of which was pitch. The information for PAT was painted on a small glass slide, about 10x10 cm. Fortunately I only wanted to vary one parameter: fundamental frequency. The outcome was surprisingly good, considering the rough spectrum presented. The samples had of course to be chosen within PAT's performing capacity. But such considerations usually have to be made also when working with very sophisticated machinery, as for example computers.

To return to Lund. Whenever questions arose, for example about where to find pertinent references or other difficulties connected with my writing, I could always turn to Eli Fisher-Jørgensen in Copenhagen, for excellent advice and information, always generously given. In 1961 I finally got my Ph.D. and a position as "docent" (assistant professor). During the 60's the number of students continued to grow. At our peak we had, I believe, about 800 students following our propaedeutic course, 80 students taking the first term course, 40 continuing

through the second term, and about 10 to 12 in their third term. This was repeated twice a year. They were all undergraduates - graduate and doctoral students were still very few and followed individual plans of study.

Naturally a great number of teachers were needed to teach all these people - but we were still only three permanently employed at the institute. Instead we were allotted so and so many "hours" each term, depending on the number of applications. As we needed teachers badly, such "hours" were given to almost anyone who had a year or so of stisfactory studies in Phonetics behind them. Their first job was to teach the propaedeutic course, the next usually to assist at lab demonstrations. We were thus able to provide work for a number of older students as "extras": as amanuenses, assistants and lecturers, even though we had no permanent lecturer position.

Most popular by far among the students was the laboratory work. Students were required to do a small instrumental-experimental study, usually in groups, and to write up and orally report on their work and results. I believe the students found it very stimulating to work with the instruments themselves on a comparatively easy problem which they felt was relevant, like analyzing their own speech, speech sounds, prosody or the like. The instruments in our lab were not too complicated either. In spite of the great number of students, we succeeded in giving everybody a working knowledge of at least one or two of our machines, and the chance to carry out a study together with others. The latter was, I think, particularly important, and I doubt whether anything similar occurred anywhere else in the language section.

Why did we have so many students? The basic reason was the fact that the language departments got an increasing number of students and that all of them had to follow our "prop". Another reason was that many, perhaps most language students aimed to become school teachers and to study at the Teacher's College. They often chose to combine two languages with Phonetics. Phonetics gave students valuable credits for admission to the College and was even considered to increase the pedagogical skill of the

future language teachers.

The 1960's were an altogether wonderfully stimulating time. It was moreover fairly easy to reach the various administrators of the university - the Central Administration was still quite small, and one knew the right person to ask or contact for the many questions that arose. Everybody was extremely helpful. During this period one felt that to work hard in the interest of the department really gave results, and it was possible to follow important matters personally. This may still be true to a certain extent, but things have without doubt become much more difficult to handle satisfactorily with the growth of the university - and of the central administration. Gradually it became almost impossible to obtain first-hand information covering the whole field of interest to our institute. To be certain, in order to learn what was going on one almost had to sit on the same committee or board as those who made the decisions. I had been used to, and much preferred, the direct, person-to-person way of handling things. That way they really got done, yet not over one's head. But, of course, we have become too many for this to be possible nowadays. As time went by I felt as if I worked harder, got less done, and had less and less influence over the outcome. Frustrating, in fact.

But let me go from the seventies back to the sixties. A third reason why our subject flourished some twenty years ago was probably that we, thanks to our laboratory, were one of the very first established institutes in our field. Not so very long ago, a language professor used to work and examine his students at home. Perhaps he had a "table" at the university library for his research. Some professors fought hard to escape the burden of a department with assistants, secretaries, administrative paper work and so on. All these meant in fact the beginning of a new era. Before, the professor was expected to lecture mainly on his own research, since he could be supposed to have the most of interest to say on that particular subject. At that time the teacher was not yet expected to regurgitate the literature for the student. There were few courses and lectures, and the stu-

dent had to study by himself, more or less unaided, until he felt that he had memorized the required literature well enough to try for an examination. If he failed more than three times he had to start in another field. No wonder that a B.A. could take quite a long time to obtain. The financial situation was often precarious. On the other hand jobs were more easily come by than now. A B.A. or M.A. was almost certain to result in a decent job in the field in which your competence lay. This was definitely so during my own student days, and I cannot recollect that we ever discussed our future as a problem, once we had decided what we wanted to do. It is true that things started getting touchier after the war, in some fields at least, but even so there was nothing like the present-day difficulties of getting any job at all.

To continue with my own experiences after receiving the Ph.D. in 1961. I had started late in life and had a lot I wanted to do. Among other things I was very keen to work at Haskins Laboratories, having heard glowing reports from those who had been there. I was happy to get an invitation from Frank Cooper in the Spring of 1962 to work at Haskins on a research fellowship. The only condition attached was that the recipient should become thoroughly acquainted with the work done at the laboratory, so that he/she could report at home on the research done there. I believe this fellowship was paid for by the Carnegie Foundation. At the beginning of the sixties this type of fellowship still existed. Nowadays I believe the requirement for somebody from outside is to join in a research project, usually on a one-year basis.

I spent three periods of four months each at Haskins and enjoyed every minute. The team spirit of the place was wonderful, and it felt natural and easy for me to work from early morning to late at night. The Haskins atmosphere was so good that there was a certain risk for us all of just swimming in well-being. After all, work had to be done too, in order for it all to survive. At first I worked with Arthur Abramson on the duration of Swedish vowels, but in the evenings I tried synthesis with, among others, the Intonator. It was not available during the day

and it had to be arranged specially at night to manage the job I wanted it to do. It was a strange feeling for a linguist with on the whole very little experience of machinery, to work for hours in the night, quite alone in a big "machine hall" (originally an old warehouse, I beleive), surrounded by equipment I knew nothing about, ticking instruments, flickering lights, and a tangle of cords. But it felt exhilarating, too, and stimulated diligent work.

After some months I started in earnest on intonation projects, now in cooperation with Michael Studdert-Kennedy, a teamwork that continued for more than 10 years. I also served as an informent for electromyographic experiments, under the supervision of Peter MacNeilage. At first only surface electrodes were used, and because I had electrodes even down on the tongue root, a medical doctor was required to spray something against too violent a gag reflex. Two young Swedish students who visited us, Björn Lindblom and Sven Öhman, grew quite pale as they looked on. But even though it was a little bit uncomfortable, it was not at all as bad as it looked. At first, too, all raw data had to be analyzed and measured by hand. Computers had begun to be used, but there was as yet no program for EMG. These direct, though time-consuming measurements meant at least one good thing - you knew everything there was to know about your data.

At that time money was easier to come by for attending congresses, meetings, and the like. I went to several during my stay at Haskins. It is tempting to describe the Congress of Linguistics in Boston, 1962, when Noam Chomsky made one of his first appearances. It was in its way unforgettable. But I think it is outside the scope of this phonetic summary.

It is also tempting to talk more about my time in New York and all it meant of meetings with people and new milieus, the latter often strange to a middle-aged visitor from a small Swedish town. Perhaps my wide-eyed and unprejudiced curiosity helped to make people show me things they would not have shown to less, let us say naive, people. I think I saw more and different sides of New York than the ordinary tourist. But when Dennis Fry arrived

from London, he found to his dismay that I had been in New York for almost one year without visiting a single museum or theatre. He took it upon himself to remedy this in a very short time. For which I am thankful! The closest I had come to "culture" before that, was to stand in line for tickets for Shakespeare's *The Tempest*, in Central Park. People were sitting in the grass for hours, whole families, with food baskets. Well, we got our tickets. It was a marvellous performance. Very appropriately a real storm, with lightning and thunder, broke out just when the script required it. Most imposing.

All this may indeed seem very far from my subject. But not really - it shows what a privilege it is to be a phonetician and therefore in a position to visit, work in, and enjoy foreign countries and places.

These months in New York were so eminently satisfactory that, when Peter Ladefoged some years later asked me, from Los Angeles, if I would take over for him in 1968, when he himself would be in Uganda, I said yes, after some hesitation. Hesitation, because one year seemed a long time to be away from home and yes, because, among other things, my time as a "docent" was running out (six years was the maximum time allowed) and there was no job in sight in Phonetics in Sweden. My wire to Ladefoged also asked: "Why me?" and I got one back saying:"Why not?".I then asked: " What am I supposed to do? " and got the answer: "Have fun!"

And I did have fun! It was great to teach American students - not least because *they* are great - and I myself learnt a lot. I think I managed quite well, all things considered. And after having had one year with intelligent, outspoken American students I did not find any other teaching situation insurmountable or even difficult. I had graduate seminars too, mostly on intonation. Much of the work, not least the management of the laboratory, grant applications etc, was done by Vicky Fromkin, an excellent linguist and administrator. I shall mention some of the participants of the seminars, and you will surely recognize their names: John Ohala (now at Berkeley), Harry Whitaker (now a neurolinguist in Maryland), Dale Teerbeek (later at Chicago),

Mona Lindau, Tim Smith, Kay Atkinson, Ralph Vanderslice, and many others, who in various ways have made well-known contributions to phonetics.

At UCLA I had another go at EMG, this time with needle electrodes, and with the help of Tim Smith and Minoru Hirano, from Japan. I was still interested in the Swedish vowels, particularly in the amazingly great number of rounded vowels. Later on in the seventies EMG studies of these vowels were continued at Haskins, this time in collaboration with Hajime Hirose, also from Japan, and now with a considerably more sophisticated instrumentation. It is true that I always found Americans wonderful to work with - but the same is true about my Japanese collegues. I remember well Jim Hirose's indefatigable work, measuring, thinking, planning the next day's "runs" when everybody else had gone home for the day. My gratitude to all the people whom I have met during my active years in phonetics is immense. Thank you all, colleagues and students, both at home and abroad!

Well, let me go back again to Sweden. In 1968, Lund finally got a university lectureship in Phonetics, which I applied for and got. I had been half prepared to stay on in the U.S. Later on, a number of chairs in Phonetics were instituted or became available - in Uppsala, Umeå, Lund. Bertil Malmberg had been "called" to chair the new subject of General Linguistics and left Phonetics. We were several who applied for them all, and I finally got the professorship in Lund, after Malmberg, in 1969.

Not very long after this, things started to deteriorate for the general linguistic subjects. The reasons were many. University studies became more job-oriented, no time could be spent on subjects which did not lead to some occupation or other, for instance school teaching. Since the various languages had a certain market value they were given priority, for example, for admission to the Teacher's College, while such subjects as General Linguistics and Phonetics gave lower credits (and later on no credit at all). State loans to students became available but did not encourage more than three years of studies altogether. In addition, students with only about two terms of study in a foreign

language were not considered good enough - three semesters were a minimum for a teacher, but three languages were preferred to two languages and phonetics, earlier a common combination. All in all: there was no longer any place for subjects like ours. Students just did not dare to stake their future on subjects which did not lead up to any jobs, which were hard enough to get in any case.

At the same time other prescriptions and rules started to affect the teaching and the administration of university departments. Foreign languages had to take over our "prop" courses themselves in order to have enough "hours" for their own people, with the result that we lost contact with the great number of new language students that we had had before. In fact, since our subject did not lead to any particular job, we lost almost all language students. Those who remained had started earlier and had found the general linguistic subjects more interesting than any other they had come into contact with. In order to continue they had to get a job in another field and then come back, often to do research. Our subject became therefore rather like a pyramid, standing on its head, with a narrow base (few undergraduates) widening upwards (many doctoral students).

It is incomprehensible to me that the schools, or rather National Board of Education does not understand that the general linguistic subjects - General Linguistics and Phonetics - form the very basis for knowledge also in the separate languages. We are the roots, or the "trunk", where the languages are the branches! But as it is, we are as often as not considered to be something on the side, something exotic, something one can do without or, if necessary, manage oneself. What a fallacy! For a long time it has been obvious that linguistic discussions, meetings, and writing tend to be dominated by general linguists, presumably because of their wider scope of interest. Now that "communication" has become an honoured word, the general linguists, whose subject is the most important of all human communication - language - will perhaps at last obtain the central place that ought to be theirs.

From this perhaps wishful thinking I return to our department in Lund as of 1979. For some time we had had to struggle for our very existance. At some point it even seemed as if our subject would disappear altogether. However, a few years ago a training program in Logopedics started in Lund. This included two terms of Phonetics and one term of Psychology, as a prerequisite for the following clinical studies. Phonetics became for the first time part of a job-oriented line of studies. At the same time several students who were or wanted to become educational speech therapists etc, started to follow our courses. This was very heartening. Because of these categories with new and different needs, our subject naturally got a somewhat different bias than before. When we were at our peak we had been able to offer our students alternative courses - not so later on, unfortunately, although our situation in 1979 should have been reason enough.

Subjects like linguistics change and develop continuously - I say linguistics and not phonetics because after all they are two sides of the same coin: human languages. That is as it should be. But also central political programs for the schools, the university and education as a whole change - but whether those changes always represent positive development may be more doubtful, so it seems to me. I have heard a rumour that there are plans to eliminate education in the humanities altogether, at least for the present and in the name of the economy. I think such a step would be disastrous. What western "humans" are running the risk of losing is their soul - as humans. And that cannot be remedied by any technical or economical tricks, however refined. What is needed is instead *more* "humanity".

The rumour may be unfounded. Nevertheless I am glad to give over the job as the head of phonetics to younger forces. For it is clear that a lot of strength and vitality will be needed in the future, perhaps now more than ever.

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SWEDISH IMMIGRANTS' COMMUNICATION: PROBLEMS OF UNDERSTANDING AND BEING UNDERSTOOD

Robert Bannert and Kenneth Hyltenstam

This project, which started in January 1980 and which is funded by the Bank of Sweden Tercentenary Foundation, aims at specifying some of the background factors involved in the problems that immigrant learners may have in understanding the target language and making themselves understood in normal communication situations in spite of the fact that they have attended language courses. One of the immediate practical purposes of the study is to provide a basis for improvements in the teaching of receptive language skills as well as in the teaching of pronunciation, especially its prosodic features.

Organizationally, the project has two parts, one dealing with problems of understanding, the other with aspects of production.

PROBLEMS OF UNDERSTANDING

The research in the first part is based on three assumptions about the learners' receptive problems:

a. The differences between language and communication in the Swedish language classroom and other ("real life") communication situations are so great that the learner remains unable to understand the target outside the classroom.
b. The heterogeneity the learner encounters in the target language, due to social, regional and registral variation, variation according to speech style etc, is an inherent problem for understanding.
c. Some types of variation in the target language cause greater problems for understanding than others, and some varieties within a given type also cause greater problems than others.

Point a: For the specification of differences between classroom and other communication situations, necessary limitations force us to concentrate on only one component of the classroom situation. We have chosen to study the language-teacher's classroom register ("language-teacher language") which we argue is in

traditional praxis the most important component in the development of the learner's ability to comprehend the target language.

Studies of language-teacher language have established that this register has a low degree of complexity on a number of structural and communicative dimensions, for example short utterances, few sentence embeddings, simple noun- and verb phrases, a high type/token ratio in the lexicon, a slow speech rate, many pauses (which in most cases fall in syntactic constituent boundaries) to mention just a few (Henzl 1973, 1979, Gaies 1977, Chaudron 1978; for an overview see Hyltenstam 1980). These characteristics of language-teacher language can be interpreted as a result of an adaptation to the learners' communicative level on behalf of the teacher, and as such of course, they would appear adequate. However, if the structural and communicative patterns of the teacher are limited in this way due to the specific constraints built into the classroom communicative situation, the learners' comprehension might be constrained in much the same way as the model provided by the teacher. Compare the often made learner statement that they understand their teacher but nobody else. We will return to language-teacher language below.

Point b: To illustrate the assumption here we have chosen to concentrate on the most obvious and best described part of target language variation, i.e. pronunciation. Our aim is to provide descriptions of sociolectal vowel quality variation within one Swedish urban dialect, the Malmö dialect, and demonstrate how in principle linguistic descriptions of this kind could be used as a basis for pedagogical programs serving to familiarize the learners with different kinds of variation. In such programs, different variants of the target language should be introduced in a systematic progression.

Point c: The research on this point aims at ranking types of variation and varieties within a certain type in order of perceptual difficulty. Such an ordering would seem to be obtainable

through a number of different methods all involving presenting speech samples to groups of listeners that are second language learners of Swedish. It would appear to be feasible to combine these various methods in order to obtain as reliable an overall measure of difficulty as possible. Some examples of these methods are:

- A straightforward judgement of which variant in a pair of variants is considered most difficult to understand.
- An imitation test where the degree of correct imitation corresponds roughly to degree of difficulty in perception.
- Questions of content.

We will not go further into points (b) and (c) here but return to point (a), the language-teacher language, which we have started to work on. (For a more detailed treatment of assumptions and research procedures of all three points, see Hyltenstam 1981)

One might consider language-teachers' classroom register from a number of perspectives, for example from the following points of view:

1. Grammar
2. Phonology
3. Lexicon
4. Semantic notions
5. Language functions
6. Turn-taking
7. General conversational structure
8. Redundancy
9. Metacommunication

Although we do have some information on points 1, 2, 3, and 8 as stated above, our knowledge is fragmentary. On the other points our ignorance is even greater. To obtain a more coherent and comprehensive picture of the register it is necessary to consider how different factors interact. In general, it can be hypothezised that the content of classroom conversation is limited in a way typical to communication between interlocuters whose spheres of values and knowledge seldom interact, i.e. the greater the social and cultural distance between the teacher and the learners, the less complex and varied the content tends to be. Whatever the causes of content restrictions - and they may be many - it is clear that this simplification has conse-

quences for the linguistics of communication. In other words, the type of content manipulated in conversation places differential demands on lexicon and grammar.

It is also plausible to assume that there is a connection between content and form on the one side and communicative structure on the other. The restrictions of the classroom make communication so ritualized when it comes to language functions, turn-taking, and general conversation structure that the language learners soon learn to predict what will be said and done in a language lesson.

Although what has just been said makes up the general framework for this part of the project, our limited personnel resources restrict us to well defined and (easily) researchable questions. One such question is whether there are some aspects of grammar that are not normally encountered in classroom conversation, and, if so, what these aspects are. One goal we have is to test whether a markedness theory built on language universals and psycholinguistic criteria can be used for predictions in this area.

In order to treat these questions, we have designed a study in which language-teachers working with learner groups of varying proficiency levels are asked to retell the contents of a prepared passage in their own words to their pupils. Their performance is videotaped and then analyzed. The passage contains certain syntactic structures and lexical elements that we predict on the basis of their markedness features will be subject to paraphrases and alterations in the teachers' version. To give just one example, the passage contains three examples of raising:

Subject to object raising: *They saw him jump out of the window*

Subject to subject raising: *He seems to be hungry*

Object to subject raising: *They are tough to open*

According to Eckman (1976) the last of these three types is more marked than the second which in turn is more marked than

the first on a language universal criterion. Our hypothesis here is that the extent to which a structure is paraphrased and simplified is a function of its markedness conditions. Data collection and analysis of these data is underway.

PROBLEMS OF BEEING UNDERSTOOD

The second part of the project considers the immigrant's own pronunciation of Swedish. The research is based on the results from the project "Optimal teaching of Swedish pronunciation", mainly on an inventory of the problems found for learners with 25 different mother tongues (Bannert 1980 a, b). We shall concentrate on three aspects of deviant pronunciation.

a. Intelligibility. Certain features of a foreign accent impair the listener's ability to understand more than others.
b. Acceptability. Certain features of a foreign accent affect the listener's attitudes more than others.
c. Hierarchies of phonetic features which affect intelligibility and acceptability negatively.

The effect of certain features on intelligibility and acceptability will be tested by manipulating features of foreign and native Swedish accents using high-quality speech synthesis and by introducing distortions into the speech signal. The salient features will be established in listening tests.

Here we would like to demonstrate the method of speech synthesis that will be used in our experiments (Bannert 1979 a, b). As a starting-point we have a taped utterance spoken by an immigrant. As a result of prior analysis we know in which aspects this utterance is deviant. A re-synthesis, i.e. a copy by computer[1] is made. The copied utterance is of high quality. It sounds totally natural and cannot be distinguished from the original. Different signal factors can be manipulated systematically, i.e. deviant features are corrected, so to speak. Swedish listeners are asked to judge the manipulated utterances. Their reactions will tell us which corrections have made it easier to understand the speech sample and which features are accepted more than others.

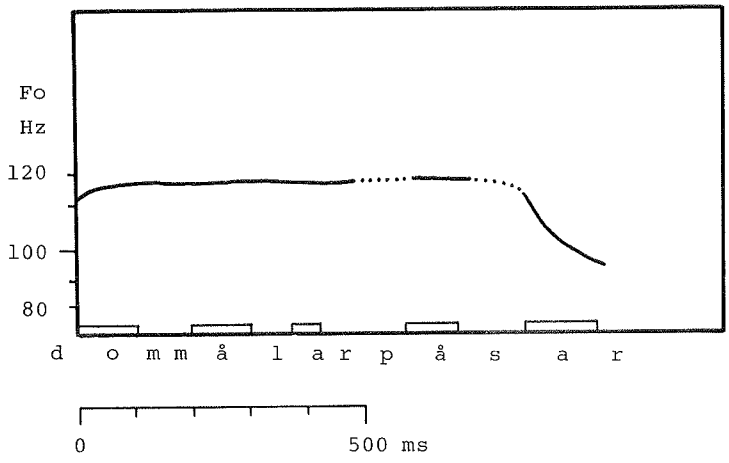

Figure 1. The tonal and rhythmic structure of the sentence *Dom målar påsar* uttered by a speaker of Punjabi.

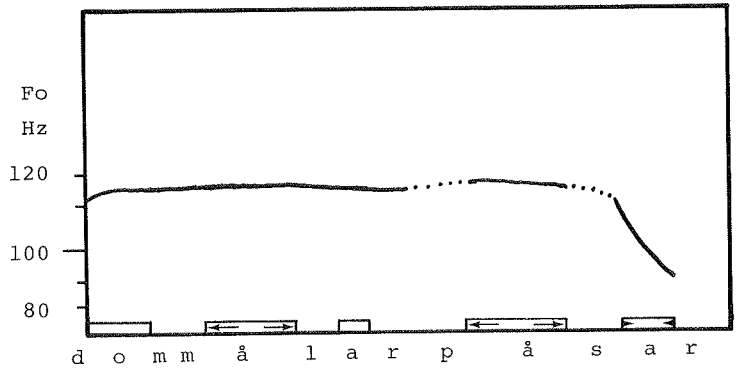

Figure 2. The same utterance as above but with corrected rhythm.

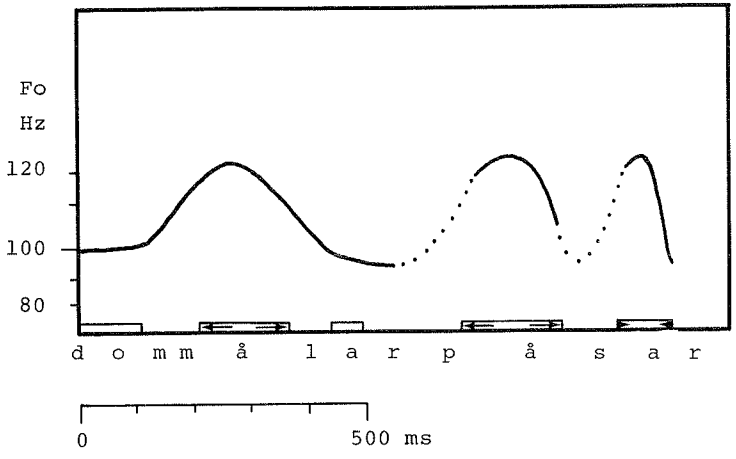

Figure 4. The same utterance as in figure 2 with corrected rhythm and Standard Swedish intonation.

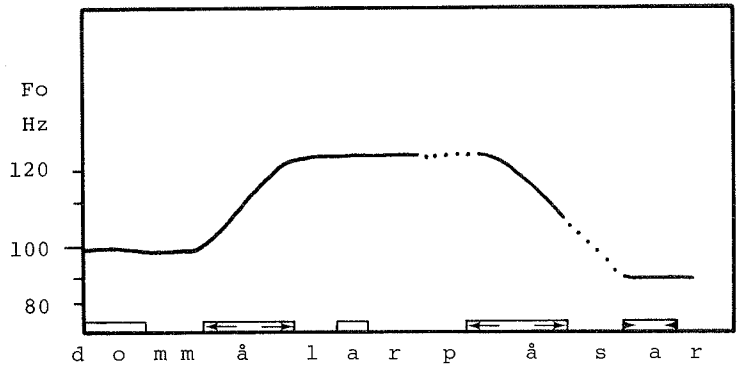

Figure 3. The same utterance as above with corrected rhythm and *Germanic* intonation.

An example of the procedure was given at this point. A person with Punjabi as his first language pronounced the following Swedish sentence as a neutral statement:

Dom målar påsar — *They are painting bags*
dɔm^{x}mo:lar^{x}pho:sar

The sound illustrations are recorded on a cassette (Bannert 1979 b).

This pronunciation was deviant in several respects. The melody was monotonous, the fundamental frequency - the pitch - being constant from the beginning of the utterance almost to its end where it dropped abruptly. There was only one stressed syllable in the whole utterance, namely the last one. This syllable was lengthened considerably and the tonal fall was located here. But this Swedish utterance should have two stressed syllables, the second and the fourth one (*må-* and *på-*). The deviant utterance did not contain any long vowel - there should have been two, namely in the stressed syllables. The vowel quality was also deviant: /o/ in the two syllables *må-* and *på-* was too open, like [ɔ], instead of the closer correct [o].

Figure 1 gives the tonal and rhythmic structure of the deviant utterance.

The first manipulation corrected the rhythm. Stress was assigned in the right place, namely on the syllables *må-* and *på-* and at the same time the stressed vowels were lengthened. Furthermore the last prolonged vowel was shortened. No other features were altered. The manipulation is shown in Fig. 2. The modified rhythm was a considerable improvement.

The next correction of the recording considered melody and was applied to the version just corrected for rhythm. The tonal contour of a sentence in Swedish contains basically the prosodic features word accent, sentence accent and sentence intonation.

Two corrections of the tonal contour (the pitch) of the original utterance were made here. First the melody of the utterance was altered into some kind of approximation of Swedish intonation,

which can be called "Germanic" intonation. This means roughly an intonation without word accents, an intonation which may be considered easier than the idiomatic Swedish intonation. The corrected melody is shown by the pitch curve in Fig. 3.

Finally, the melody was refined to contain all the tonal features of Swedish, including word accent, which had been excluded in the previous version. The Standard Swedish variety of intonation was used here. The new melody corresponds to the melody with which a speaker from Stockholm would pronounce the sentence. This is shown in Fig. 4. Comparison with the pitch contour in Fig. 3. shows that the Swedish melody is more complex than the "Germanic" one.

The last version sounded very Swedish, although some minor deviances such as vowel quality still remained.

When manipulating deviant samples of Swedish sentences we will focus on certain features and their interrelations. This constraint is due not only to practical limitations but also to the fact that deviant features differ as to their effect on intelligibility and acceptability. Here is a possible selection of these salient features to serve as a guide for the design of the experiments:

Features pertaining to *rhythm*	STRESS (word, phrase)
	SENTENCE RHYTHM
	SYLLABIC WORD STRUCTURE
Features pertaining to *segments*	QUALITY of *certain* vowels and consonants
	OBSTRUENT CLUSTERS

The project will be most useful in indicating ways in which classroom language and communication could be brought closer to normal communication situations and how target language heterogeneity could be more systematically taken into consideration in teaching receptive skills. In the teaching of pronunciation it will be possible to concentrate on those features that are most important for the listener.

FOOTNOTE

To appear in Linguistische Arbeitsberichte (LAB), Berlin.

1. The manipulations were made at the Institute of Linguistics, Uppsala University by courtesy of Professor Sven Öhman and with the kind assistance of Staffan Zetterlund. The method is called Linear Prediction Coding (LPC).

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THE GREEK VOWELS

Antonis Botinis

PURPOSE

The purpose of this paper is to investigate the phonetic quality of the Greek vowels. Apart from the value of presenting a phonetic description of the Greek vowels, this will also provide a test of the Liljencrantz-Lindblom model of maximal dispersion of vowels.

GENERAL

Some investigators have supported the view that perception of sounds is related to articulation (Liberman et al., 1967). Ladefoged et al. (1972) argue in favor of acoustics in relation to vowel perception and propose "An auditory-motor theory of speech production". Distinctive features for vowels have been reviewed by Lindau (1978).

Phoneticians have realized that the first two or three spectral peaks, i.e. the formants, suffice to distinguish between different vowels. It is tempting to see the dimension height of traditional vowel diagrams inversely related to the frequency of the first formant and the dimension backness directly related to the frequency of the second formant. But the relationship between vowel formants and tongue height or backing is more complicated than this (Stevens and House 1975, Fant 1960, Lindblom and Sundberg 1971, Stevens 1972, Wood 1975a, 1975b, 1978, 1979). Ladefoged (1975) has proposed relating backness to the difference between the two formants rather than to the second formant alone. This procedure will be adopted here.

It has been shown by Peterson and Barney (1952) that two speakers may produce perceptually the same vowels with overlapping formant frequencies because of the differences in vocal tract dimensions. A desirable requirement for the comparison of vowels in languages or dialects is the elimination of the particular speaker characteristics, leaving only the phonetic

	[i]		[e]		[a]		[o]		[u]	
S	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
1	290	2000	430	1750	710	1290	430	1110	325	1000
2	360	2215	500	1835	820	1605	500	1000	390	930
3	360	2390	465	1820	785	1570	465	1070	430	1000
4	430	2285	430	1785	785	1355	430	1105	390	890
5	320	2265	500	1570	785	1250	465	890	390	930

Table 1. Formant frequency values (Hz) of 5 speakers representing Athenian Greek.

quality common to all speakers of the language. Thus, it becomes necessary to investigate the vowels of several speakers to represent the system of a language. The speech of 5 subjects will be analysed here.

Liljencrantz and Lindblom (1972) provide a quantified theory of the principle of maximal contrast as the major factor influencing the acoustic vowel space according to which the vowels in a system will tend to be maximally dispersed from a center of gravitiy in the available formant space. Wood (1975a), Papçun (1976) and Disner (1978) looked at formant data in real languages and their results indicate that some vowel spaces are not determined completely by a principle of maximal separation. The Greek data analysed here will be viewed in the light of this theory.

VOWEL		[i]	[e]	[a]	[o]	[u]
F1	$\bar{X}$	350	465	775	460	385
	S	45	35	35	25	35
F2-F1	$\bar{X}$	1880	1285	635	575	565
	S	45	110	100	100	35

Table 2. Mean values ($\bar{X}$) and standard deviations (S) of formant frequencies of 5 speakers representing Athenian Greek.

EXPERIMENTAL PROCEDURE

Formant frequency data of the five monophthongal Greek vowels /i e a o u/ were obtained from five speakers producing short utterances containing the vowels to be analysed.

Subjects

Five male Greek students in their twenties, brought up and educated in Athens, served as informants. They all speak what is considered to be standard Athenian. Apart from subject 5 (the investigator) , the subjects have never had any phonetic training.

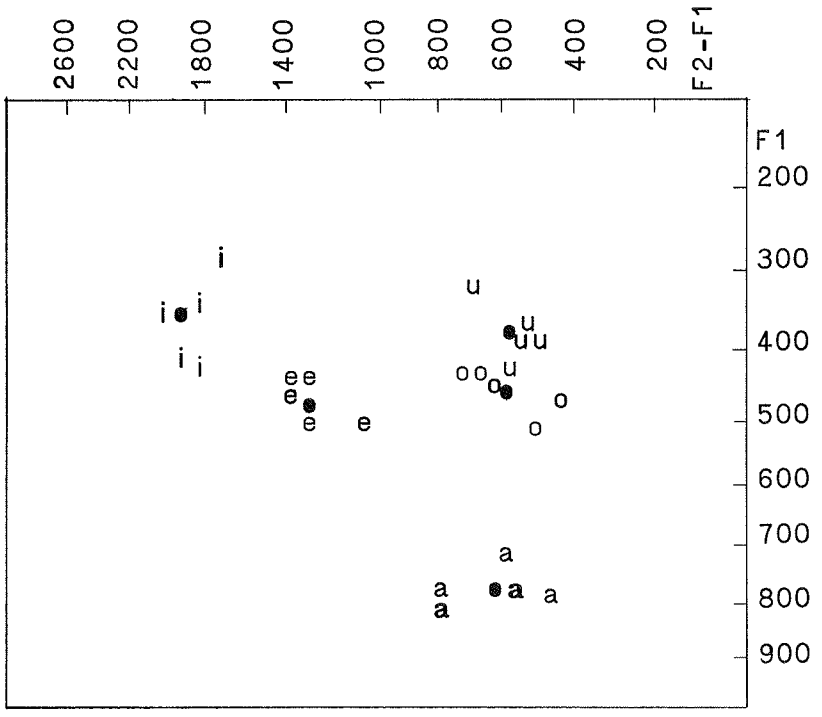

Fig.1. The formant frequencies from Table 2 with the average for each vowel indicated.

Speech samples

Five monosyllabic words of the type CV, each representing one Greek vowel, were put in the frame *Ɣráρse...páli* "write ... once more". Below is the list of the CV-words.

ti what
te and (formal and archaic Greek)
ta definite article, neuter, plural
to definite article, neuter, singular
tu definite article, genitive, singular

The list of "sentences" was read three times by each speaker. The subjects were instructed to read the list in a natural way.

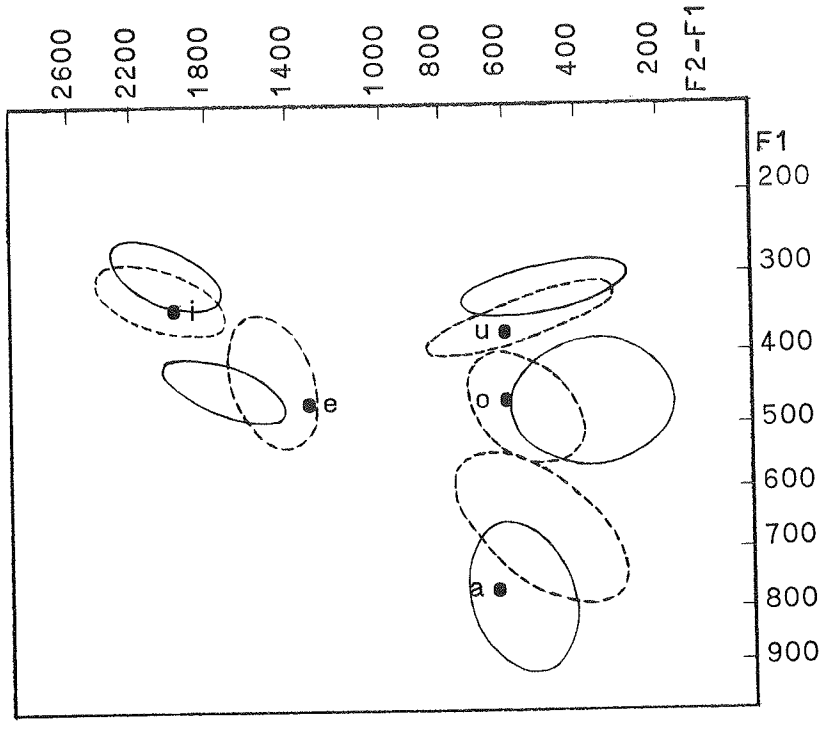

Fig.2. The formant frequencies of Mexican Spanish (solid lines) and Peninsular Spanish (broken lines) from Godinez (1978). The average formant frequencies of the Greek vowels are indicated by dots.

Experimental equipment

The recording took place in a sound-treated studio. The frequency response of the tape recorder was flat within ± 2 dB, from 30 Hz to 14 000 Hz. The signal to noise ratio was 63 dB. The microphone was unidirectional within the frequencies 30 to 17 000 Hz, and the sound spectrograph was a PV-10 voiceprint.

Acoustic analysis

Wide band spectrograms were made of the middle set of utterances and the first two formant frequencies of each of the five vowels were measured by the investigator (Table 1). Mean values and standard deviations of formant one and the difference between formant one and formant two were also calculated (Table 2).

RESULTS

Figure 1 shows the formant space of the five Greek vowels plotted with the frequency of the first formant on the ordinate and the difference between the first and second formant on the abscissa. Distances along the axes are arranged in accordance with the Mel-scale, in which perceptually equal intervals of pitch are represented as equal distances along the scale (Ladefoged 1975).

DISCUSSION

The Greek vowel space does not completely conform to a principle of maximal disperson. Some vowels do not utilise the full acoustic space. First, the vowels [u] and [o] are too close together. Second, the vowel [e] is considerably centralized.

The Greek vowel space was compared with the vowel spaces of two Spanish dialects, Mexican and Peninsular Spanish (Godínez 1978). Figure 2 shows the comparison. First, the average [i] and [u] of Greek is somewhat lower than in Spanish. This is what makes Greek [u] and [o] closer together than expected from a principle of maximal dispersion. Second, the Greek [e] is centralized in comparison with Spanish. This shrinks the Greek backness dimension.

Maximal dispersion is one factor governing the Greek vowel space. However it is clearly not the only one; examination of the historical development of the Spanish and Greek vowels may cast some light on the observed differences between the two languages. First, in modern Greek the vowel /e/ has come both from the short classical /e/ and the classical diphthong /ai/; this merger of /ai/ with /e/ may have contributed to the central value of modern Greek /e/. Spanish has never had this kind of vowel change. Second, the modern Greek /u/ has derived successively from the pre-classical diphthong [ou] via mid close [o:] to the classical [u] . On the other hand, the Spanish /u/ has come directly from the classical Latin /u:/. That the Greek /u/ is lower than Spanish /u/ indicates that the modern Greek vowel may reflect its development from classical Greek.

Thus, the current Greek vowel space may be the result of the principle of maximal dispersion and the historical development of the Greek vowel sounds; but there may be other factors involved too.

This work has been done in a course taught by Mona Lindau. She has given me substantial help which I gratefully acknowledge. I have also profited from discussions with Sidney Wood.

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TONAL INTERACTION BETWEEN ATTITUDE AND GRAMMAR

Anne-Christine Bredvad-Jensen

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1 INTRODUCTION

From time to time the effect of different attitudes and emotions on spoken language has been a subject of interest to linguists, e.g. Hadding-Koch (1961) in her study on southern Swedish intonation. The following is an account of a preliminary investigation into how different attitudes may effect the tonal pattern of declarative and interrogative sentences in Swedish. Several factors can be taken to influence fundamental frequency (Fo)which is the primary acoustic correlate of intonation. Some possible factors are: (a) grammatical sentence structure (which is a result of factors such as position of sentence accent (SA) and declarative or interrogative function of the sentence); (b) attitude of the speaker; and (c) sentence context. Here I will deal with points (a) and (b) and investigate in what way a certain grammatical structure and a certain attitude of the speaker will interact to yield a specific Fo-contour. In this study context will not be changed for a given combination of grammatical structure and attitude, except for SA. Of course attitude of the speaker may also affect other speech parameters than Fo such as duration, intensity, formant frequencies and voice quality.

2 THE MEANINGS OF INTONATION

Cruttenden (1979a) assumes that the meanings of intonation, particularly those associated with the basic division between rising and falling tunes, can be ascribed to a level of abstraction higher than grammar, attitude, lexis or discourse. Meanings associated with falling tunes are labelled 'strong'

while meanings associated with rising tunes are labelled 'weak'. He also states (1979b, p.18) that "the use of fall and rise to mark one dimension of meaning will imply its use to mark certain other dimensions, e.g. if the difference between fall and rise is used to mark an attitudinal distinction between neutral and deferential, it will also be used to mark the distinction between statement and question". Further, if there is a conflict of applicability between different dimensions of meaning demanding usage of 'strong' tunes in one dimension and usage of 'weak' tunes in another, then "a required attitudinal usage will always overrule a required grammatical usage" (Cruttenden 1979b, p.18).

3 THE MEANINGS OF INTONATION IN SWEDISH

Now the distinction between terminal rise and fall can be used to signal the distinction between declarative and interrogative function also for Swedish sentences. However, a description of Swedish interrogative intonation involves the change of several parameters, as is shown by Gårding (1979, p.215). She concludes that the most important cue to interrogative intonation is probably the extra widening of the frequency register in connection with the SA manifestation. However, the perceptual relevance of this assumption has not yet been tested. Bredvad-Jensen (1980) describes tonal correlates of the interrogative function in a southern Swedish dialect. She uses three main correlates to describe the interrogative function of both yes/no and wh-questions, and for yes/no questions she needs an additional tonal correlate. These will be presented in connection with Fig.2. The results are similar to Gårding's but described in different terms. It seems clear that for the southern Swedish dialect reported here, sentence intonation exhibits more than one parameter of importance in the tonal curve, making clear the distinction between declarative and interrogative function. Therefore it seems natural to assume that, for Swedish, the two assumptions made by Cruttenden (1979b, p.18) probably cannot be applied without adapting them to these new conditions.

It seems plausible that fall-versus-rise is one of several parameters which can be used to mark both the attitudinal and the grammatical distinctions and it also seems likely that not all of these parameters are used simultaneously and to the same extent to mark these distinctions. When listening to Swedish I can easily tell a deferential declarative utterance (= 'weak' category for attitudinal reasons) from a question (= 'weak' category for grammatical reasons). Is this so for contextual (and other) reasons only or is there some tonal evidence which can explain the perceptual impression?

4 PROCEDURE

The recorded speech material is shown in Table 1.

Statement		Manne lämnar nallarna. Manne is leaving the teddy-bears.
Yes/no question	SVO-question	Manne lämnar nallarna? Manne is leaving the teddy-bears?
	VSO-question	Lämnar Manne nallarna? Is Manne leaving the teddy-bears?

Table 1. The speech material. SVO refers to unreversed word order and VSO refers to reversed word order.

The sentences were first uttered in a neutral way, then the informant was asked to talk with a polite attitude and finally with a determined attitude. The informant was given imagined situations as a help to elicit the demanded attitude. She had no trouble following the instructions. The attitudes are chosen to fit in the two categories discussed by Cruttenden, the polite attitude as an example of the 'weak' category and the determined attitude as an example of the 'strong' category.

For each sentence the position of sentence accent (SA) was systematically varied, so that either of the three words in the sentences receive SA. Thus for each sentence listed above there were three different versions with SA either in initial, medial or final position, which amounts to a total of 3 x 3 = 9

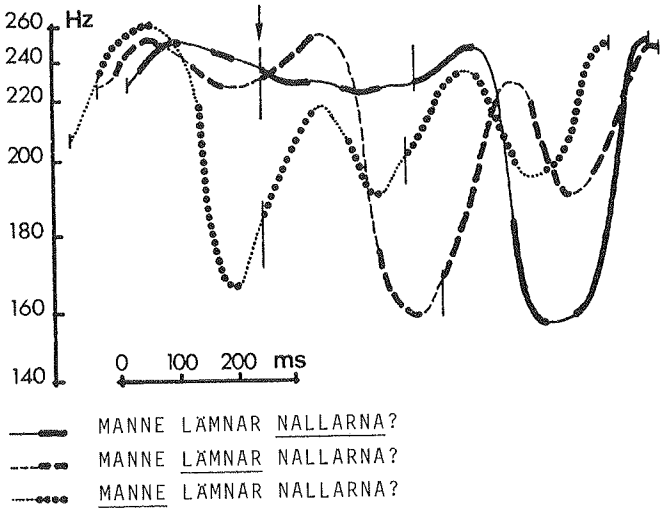


Figure 1. The effect of sentence accent on the tonal contour of neutral SVO-questions. Sentence accented words are underlined.

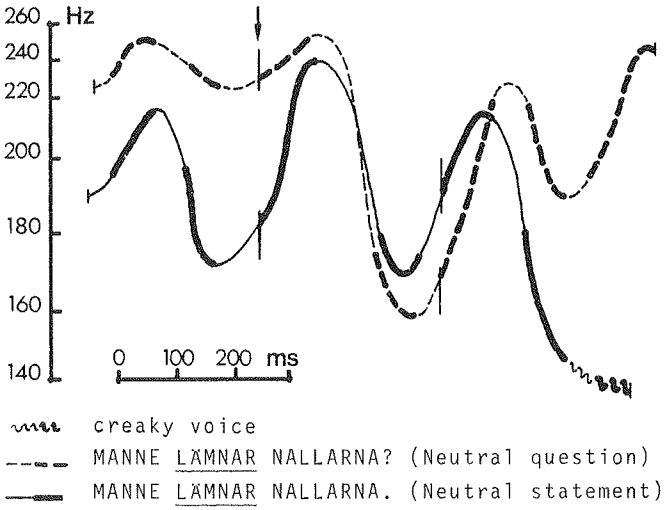


Figure 2. The effect of interrogative function. A comparison of neutral SVO-questions and structurally corresponding neutral statements. SA in the medial position.

sentences, each recorded five times. Each sentence was preceded by a context sentence, which is a question which is designed to elicit the appropriate SA in the following sentence. An example of a question/question pair is (SA position in italics): Manne gör vaddå med nallarna? Manne *lämnar* nallarna? ('Manne is doing what with the teddy-bears? Manne *is leaving* the teddy-bears?') For a more thorough discussion of the sentence accent concept and its use see Bruce (1977, p.20-24). Here SA and focus will be treated as equivalent concepts.

To obtain continuous Fo-contours which are fairly undisturbed by segmental factors, the test words are composed of sonorant consonants and vowels of the same degree of opening, here non-high vowels.

The main informant, whose tonal contours will be shown in the figures, is a female, non-phonetician student from Halmstad, which belongs to the south dialect area in Sweden. The tonal contours of a female phonetician from the same dialect area (myself) will be used as a reference.

5 ANALYSIS AND DISCUSSION OF Fo-CONTOURS

Explanation of notation used in connection with the figures.

The word which receives SA is underlined in the text. The arrow points to a common line-up point in the time domain for the contours involved, here the first CV-boundary in the medial word. A vertical bar indicates the first CV-boundary in each of the last two words in each sentence. Thick contour lines indicate vowels and thin contour lines indicate the consonantal part of the contour.

The position of SA governs the course of the Fo contours as can be seen in the neutral question contours in *Fig.*1. A very wide frequency range is manifested in connection with the sentence accented word. The prefocal contour varies within a very limited frequency range and the postfocal contour is in between. The contours also lie within the same frequency ranges. In the following I shall concentrate the analysis on the sentences

with SA in the medial position.

In *Fig.2* the neutral statement with SA in the medial position is compared to the corresponding SVO-qusestion. These sentences are structurally identical only differing in grammatical function, i.e., declarative versus interrogative. The statement belongs to the 'strong' and the question to the 'weak' category on the grammatical level. Now this difference in function greatly influences the tonal contour, as was pointed out in Bredvad-Jensen (1980). Four points of comparison can be set up:
(a) The wide interval in connection with SA for the statement (see Bruce and Gårding 1978, p.222-223) is still wider for the question.
(b) The prefocal and postfocal Fo-contours in the question are compressed in comparison with the statement contour.
(c) The question contour is charactarized by a higher overall frequency level in comparison with the statement.
(d) The question terminates with a rise and the statement with a fall, which is very pronounced, ending in a creaky voice.
Points (a) and (d) can be called local features in the sense that these modifications influence only certain smaller parts of the Fo-contour. On the other hand point (b) and (c) can be called global features implying an influence on a larger part of the Fo-contour. Looking at the meaning distinction on the grammatical level and its tonal correlates it seems as if we tentatively could refer to the 'strong'-'weak' dichotomy using the above mentioned points (a) to (d), as a way of specifying the tonal distinctions found on the grammatical level.

In *Fig.3* the neutral SVO-question is compared with the corresponding VSO-question, where the interrogative function is also marked by the reversed word order. The similarities between the two Fo-contours are apparent, appart from the difference in degree of the frequency range in connection with SA. But still, the tonal Fo-contour of the VSO-qusetion is clearly distinct from the statement contour and the same points of comparison are valid for both the VSO and for the SVO-question.

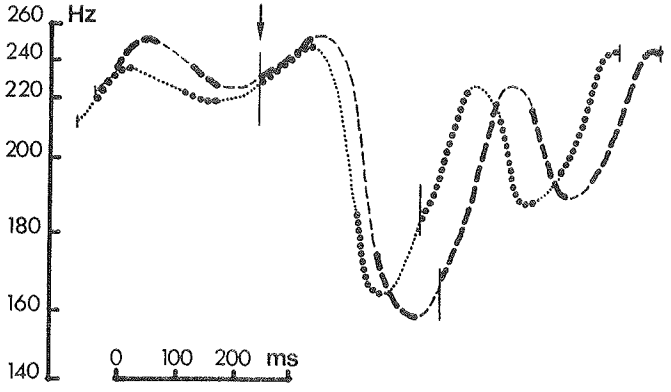


Figure 3. The effect of reversed word order on questions. SA in the medial position.

In *Fig.4* a neutral statement is compared with a polite statement. A neutral statement belongs to the 'strong' category but for the polite statement we arrive at a *tonal conflict*. In the attitudinal dimension the sentence must belong to the 'weak' category and in the grammatical dimension it must belong to the 'strong' category. According to Cruttenden, a required attitudinal usage will always overrule a required grammatical usage, but for the polite statement the conflict is resolved in a different way, as can be seen in Fig.4. The wide frequency range in connection with SA is still wider for the polite statement and this is the same as point (a) above. For the other points we find no similarities between the neutral question and the polite statement, but rather a tendency in the opposite direction for point (b), implying a frequency expansion outside focus too. The statement contour is modified by the attitude, but the shape of the contour is more similar to the neutral statement than to the question contours in Fig.5.

Figure 5 also exhibits a case of *tonal conflict* for the determined question, which belongs to the 'weak' category in the grammatical dimension but belongs to the 'strong' category in

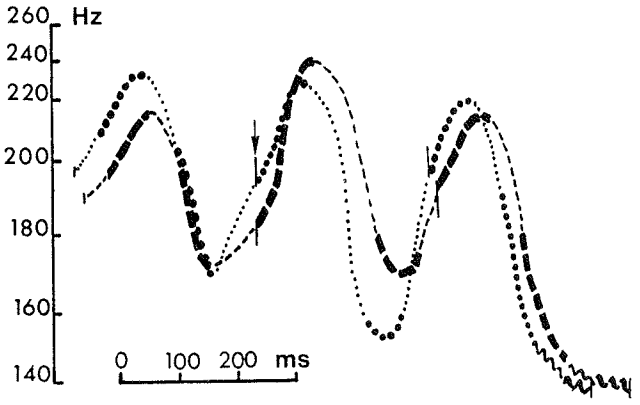


Figure 4. The effect of polite attitude on statements. SA in medial position.

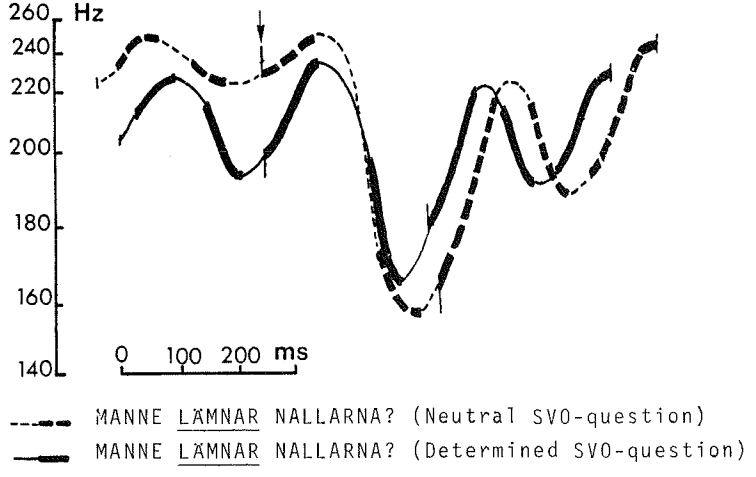
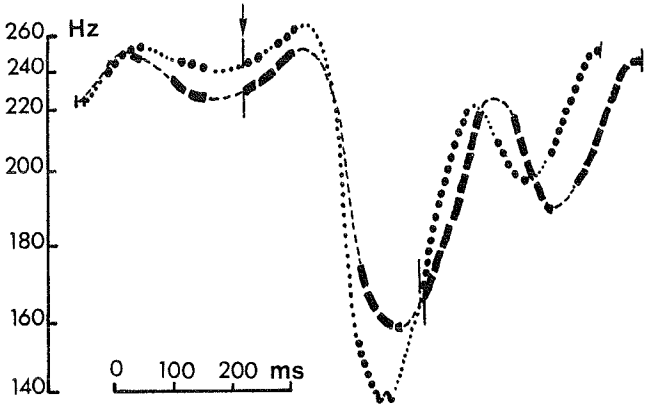
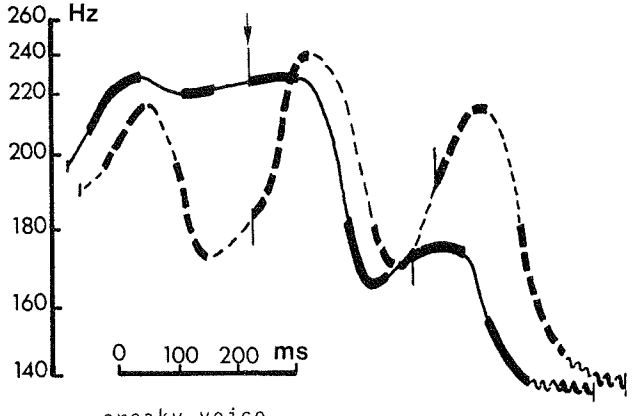


Figure 5. The effect of determined attitude on SVO-questions. SA in medial position.



creaky voice
MANNE LÄMNAR NALLARNA? (Neutral SVO-question)
MANNE LÄMNAR NALLARNA? (Polite SVO-question)

Figure 6. The effect of polite attitude on SVO-questions. SA in medial position.



creaky voice
MANNE LÄMNAR NALLARNA. (Neutral statement)
MANNE LÄMNAR NALLARNA. (Determined statement)

Figure 7. The effect of determined attitude on statements. SA in medial position.

the attitudinal dimension. The conflict is solved in such a way that both 'weak' and 'strong' demands are satisfied. In comparing the determined question with the neutral question we find: (a) that the SA frequency range is compressed just as for the corresponding statement; (b) less prefocal compression, but more than for the statement; (c) not as high overall frequency level, but higher than for the statement; and (d) a somewhat less marked final rise.

Thus we have found for the two cases of *tonal conflict* related here, that attitudinal considerations do not overrule grammatical ones, but modify the tonal curve. This modification will not extinguish the grammatical character (statement versus question) exhibited in the Fo-contours. The whole pattern will never be changed; only range changes are shown.

Is it possible to detect a *tonal strengthening* effect in Fo-contours if a sentence belongs to the same category for both grammatical and attitudinal reasons? In the polite question in *Fig.6*, which belongs to the 'weak' category for both grammatical and attitudinal reasons, the strongest tendency is point (a), the frequency expansion in connection with SA. The Fo-contour seems to be a strengthening of the pattern for the neutral question. This frequency-expansion parameter is also the one which is mostly affected by the polite attitude, cf. Fig.4.

In *Fig.7* we also have a possible candidate for a *tonal strengthening* effect, as the determined statement belongs to the 'strong' category for both grammatical reasons (declarative function) and for attitudinal reasons (determined attitude). Going from polite to neutral attitude achieves a compression in connection with SA, but could going from neutral to determined attitude achieve a further compression for SA? How can a strengthening effect be achieved without damaging the impression of the medial focus position? As can be seen in Fig.7, a radical frequency compression in the prefocal and postfocal parts of the contour is achieved, probably emphasizing the impression of SA fall and adding to the impression of finality in this utterance. Thus it seems as if a frequency compression outside focus is not reserved for interrogative expressions only.

		TONAL PARAMETERS			
		FREQUENCY RANGE IN CONNECTION WITH SA (a)	PREFOCAL AND POSTFOCAL CONTOUR (b)	OVERALL FREQUENCY LEVEL (c)	TERMINAL RISE OR FALL (d)
'WEAK' USAGE	QUESTION	expanded	compressed	higher	rise
	POLITENESS	expanded	compressed (Q) expanded (S)	no change (S) higher (Q)	no change
'STRONG' USAGE	STATEMENT	compressed	expanded	lower	fall
	DETERMINATION	no change (S) compressed (Q)	expanded (Q) compressed (S)	no change (S) lower (Q)	no (little) change

Table 2. Tendencies in the relations between the tonal parameters and their different usages. S= for statements, Q= for questions.

6 SUMMARY

Two different attitudes, besides neutrality, were investigated, namely an attitude of politeness and one of determination. The effect of these attitudes on the tonal contour was related to the effect of declarative versus interrogative function of a sentence. The dichotomy between 'strong' and 'weak' meanings was adapted from Cruttenden. 'Strong' meanings include statements in the grammatical dimension and determined attitude in the attitudinal dimension whereas 'weak' meanings include questions and polite attitude. Table 2 summarizes the discussion of the 'strong' and 'weak' usages of the tonal parameters.
It was found that there was no simple one-to-one correspondence for either the 'weak' tonal correlates or for the 'strong' tonal correlates used in the different dimensions. This is contrary to the assumptions of Cruttenden but in accordance with the assumptions made in section 3. Cases of *tonal conflict*, i.e. 'weak' and 'strong' demands simultaneously in different dimensions, also showed that attitudinal considerations do not overrule grammatical ones, but modify the tonal contour in such a way that the grammatical character of the contour is preserved. Cases of *tonal strengthening* showed that the non-focal frequency compression may not be an interrogatory feature per se. Rather it seems as if it helps to emphasize the character displayed especially in the frequency range changes

in connection with sentence accent, for both questions and statements. A preliminary answer to the question raised in section 3 is that, yes, for this person it seems as if not only context, syntax, etc., but also the character of the tonal contours explain the perceptual impression.

7 CONCLUDING REMARKS

The relations between the different tonal parameters are the same for the VSO- and the SVO-questions, though differences in degree may occur. This is also valid for the relations exhibited in the sentences with SA in either the initial or final position, where some minor adjustment in connection with sentence accent position is shown. Also, the data from my own speech exhibit the same relations as the material from the main informant.

The perceptual importance of the different tonal parameters has not been studied yet, but is of course crucial to the interpretation of the data presented here. At present more data is being collected and perceptual experiments are planned.

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TONAL AND TEMPORAL INTERPLAY

Gösta Bruce

INTRODUCTION

When in my thesis I discussed the interplay of tonal commands, I assumed a basically fixed temporal program (Bruce 1977, chapter 5). The observed tonal adjustments, e.g. interruption, anticipation and delay of Fo-changes, were interpreted as the result of an adaptation to the given time restrictions in cases where tonal commands conflict. This tonal dependence on the temporal setting is presupposed in the intonation models in Bruce (1977, chapter 8) and Bruce and Gårding (1978). The rationale for this view is that certain rhythmical demands connected to the concept of isochrony must be fulfilled.

The same view that the temporal program is basic and the tonal program has to adjust to it finds support in a study by Erikson (1973) on the synchronization of the onset of the secondary stress syllable and the Fo-contour in Swedish disyllabic compounds. An increase in the number of consonants in the medial cluster and thus a delay of the second vowel onset will cause a corresponding delay of the Fo-contour of this syllable. In their modeling of the temporal organization of Swedish utterances Lindblom et al. (1976) also imply a temporal independence from tonal events.

Recent work on tonal and temporal interplay lends support to a different view of this dependence. In a study of final lengthening, Lyberg (1979) suggests that the final lengthening observed in Swedish may at least partly be a function of the fundamental frequency change required in final position. This is to say that tonal demands might govern the durations of the segments involved.

Öhman et al. (1979) hypothesize that the actual durations of segments may be secondary effects of other, "primary acoustic effects". For example they have found that an Fo-change covering a wide range tends to lengthen the segments involved.

In their extreme form these two hypotheses about tonal and temporal interplay make opposite predictions (cf. Lindblom's discussion in Nordic Prosody 1978, pp. 293-295). Figure 1 is an attempt to illustrate the consequences of the hypotheses for the tonal and temporal domains. For each

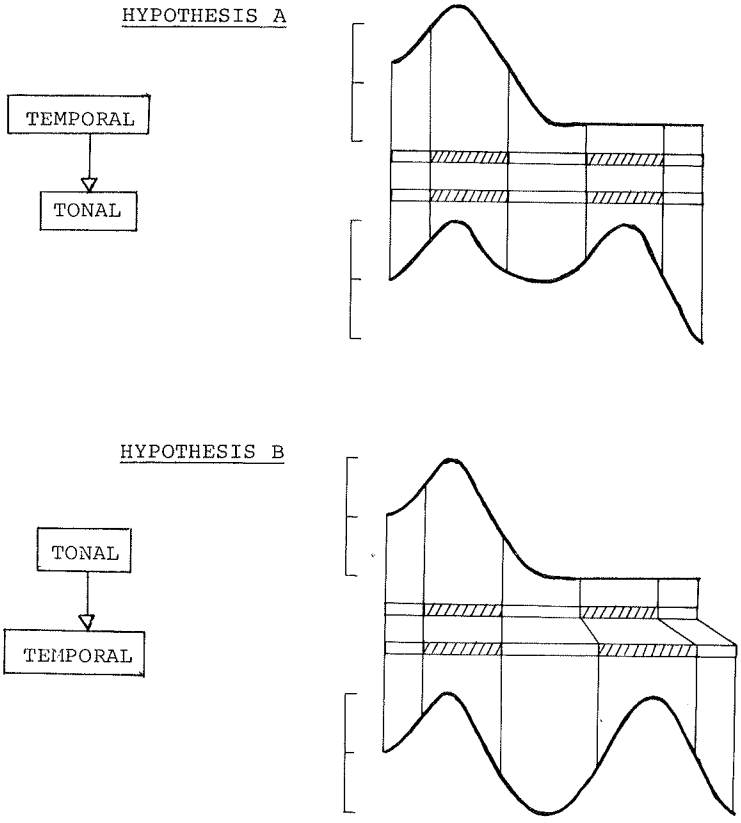

Figure 1. Illustration of consequences of two opposite hypotheses about tonal and temporal interplay for the Fo-contour and segment durations. For each hypothesis a simpler (upper part) and a more complex (lower part) Fo-contour is shown.

hypothesis a simpler (upper part) and a more complex Fo-contour are shown. These hypothetical Fo-contours are similar to those found in a Standard Swedish accent 2-word in non-focal and focal position respectively.

According to hypothesis A (temporal-to-tonal) the addition of a second rise-fall after the first one forces Fo to make a shortcut - interruption of the Fo-fall by the immediately following rise - to fit a fixed temporal program. Hypothesis B (tonal-to-temporal), on the other hand, predicts that adding another rise-fall to the first one will cause a lenghtening of the

actual segments.

The purpose of the present study is to study the tonal and temporal interplay in the light of these two extreme hypotheses. It should be pointed out from the beginning that they serve as null hypotheses against which this interplay can be studied. One way of doing this, the one that will be used here, is to keep the segmental context constant (or nearly constant) and vary the tonal context. Standard Swedish with its relatively complex tonal system offers good possibilities for studying this interplay.

TEST MATERIAL AND INFORMANTS

The test material for this study consists of a subset of the test material used in my thesis (Bruce 1977) and recorded by my main informant. In this material placement of sentence accent was varied (three different focus locations), and for the (first and) final focus location choice of word accent. The following sonorant test sentence are included. The portions within parentheses have not been analysed for this study:

(Nian vill $\begin{Bmatrix} 1 \\ \text{a}\acute{}\text{namma} \\ \text{}\grave{}\text{lämna} \end{Bmatrix}$ nåra) $\grave{}$långa $\begin{Bmatrix} 3 \\ \acute{}\text{nummer} \\ \grave{}\text{nunnor} \end{Bmatrix}$.(One wants to $\begin{Bmatrix} 1 \\ \text{accept} \\ \text{leave} \end{Bmatrix}$ some) $\begin{Bmatrix} 2 \\ \text{long} \\ \text{tall} \end{Bmatrix}$ $\begin{Bmatrix} 3 \\ \text{numbers} \\ \text{nuns} \end{Bmatrix}$.

A similar material was recorded by a second informant:

(Dom vill $\grave{}$slippa) $\grave{}$långa $\begin{Bmatrix} 3 \\ \acute{}\text{nummer} \\ \grave{}\text{nunnor} \end{Bmatrix}$. (They want to avoid) $\begin{Bmatrix} 2 \\ \text{long} \\ \text{tall} \end{Bmatrix}$ $\begin{Bmatrix} 3 \\ \text{numbers} \\ \text{nuns} \end{Bmatrix}$.

In addition a parallel material in an obstruent context, where segmentation difficulties are judged to be less than in a sonorant environment, was recorded by the same informant. Besides varying the placement of sentence accent and choice of word accent in final position in this material, the phrase structure of the last part of the sentence containing either one word (compound) or two words was varied. Variation of the placement of secondary stress in the compound was also included:

Dom vill $\grave{}$slippa $\grave{}$nacka $\begin{Bmatrix} 3 \\ \acute{}\text{skotten} \\ \grave{}\text{skotten} \end{Bmatrix}$. They want to avoid chopping the $\begin{Bmatrix} 3 \\ \text{shoots} \\ \text{Scotsman} \end{Bmatrix}$.

Dom vill $\grave{}$slippa $\grave{}$nacka, skotten. They want to avoid the Nacka-Scotsman.

(Dom vill $\grave{}$slippa) $\begin{Bmatrix} 2 \\ \grave{}\text{nacka, schacket} \\ \grave{}\text{nackajac, kett} \end{Bmatrix}$.(They want to avoid) the $\begin{Bmatrix} 2 \\ \text{Nacka-chess} \\ \text{Nacka-coat} \end{Bmatrix}$.

Both informants are female and represent the Stockholm variety of Standard Swedish.

RESULTS

Figures 2 and 3 show average values of segment durations and Fo-peaks and valleys of sonorant test phrases for the two speakers.

In non-final position the two speakers seem to use different strategies. For the word ˋlånga speaker EH appears to have approximately the same durations in focal (Fig 2, medial part) and pre-focal position (Fig 2, upper part). The higher tonal demands of the focus - because of the sentence accent rise, which is absent out of focus (cf. Bruce 1977, chapter 3) - result in an interruption of the word accent fall by the sentence accent rise in ˋlånga. This is evident for ˋlånga in the context of the accent 2-word ˋnunnor (Fig 2, right column), while the situation in the context of the accent 1-word ˊnummer (Fig 2, left column) is less clear-cut.

Speaker UN, on the other hand, lengthens all segments in ˋlånga in focal position (Fig 3, medial part), as compared to pre-focal position (Fig 3, upper part). This lengthening is non-uniform, however, and affects mainly the duration of the long consonant [ŋ:] in ˋlånga. No interruption of the word accent fall is apparent. In fact, the range of the Fo-fall is wider in focal than in pre-focal position. In particular the extra increase of the long consonant might be explained by reference to the higher tonal demands of the focus,with the sentence accent rise involving mainly this segment.

In final position, however, the speakers use similar strategies. For the accent 2-word ˋnunnor the durations are longer in focal (Figs. 2 and 3, upper part) than in post-focal position (Figs. 2 and 3, medial part). The lengthening is found mainly for the long consonant [n:] and the final vowel [ɔ], exactly those segments where a temporal adaptation to tonal demands should be expected in focal position, as the sentence accent rise and the terminal jucture fall - which are absent in post-focal position - are manifested here (cf. Bruce 1977, chapter 3). The range of the word accent fall is clearly wider in post-focal position, however. In focus the word accent fall in ˋnunnor is interrupted by the sentence accent rise. This means that for both speakers we have a tonal as well as a temporal adaptation in focal position. A parallel picture is found also for the

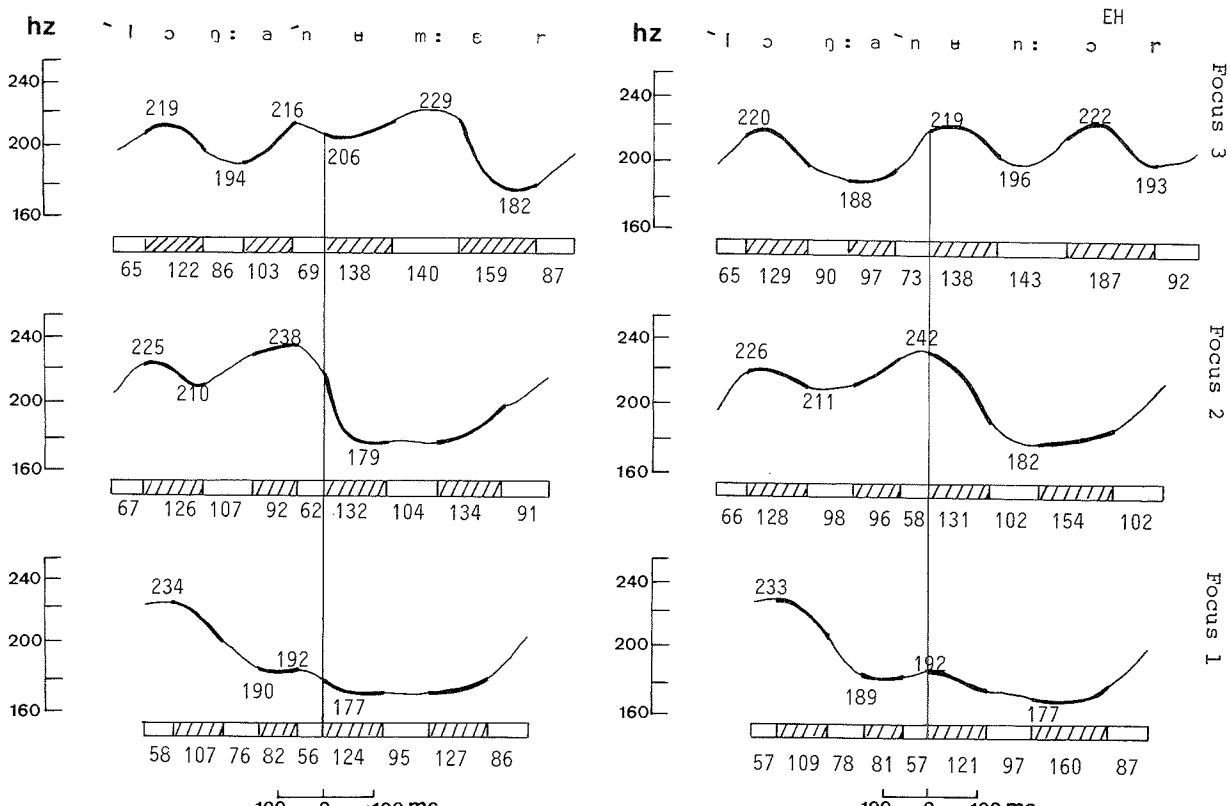

Figure 2. The effect of the placement of sentence accent and choice of word accent. Speaker EH. Typical Fo-contours for two-word phrases in sentence final position. Mean values of 10-14 repetitions of Fo-peaks and valleys and segment durations. The line-up point is at the CV-boundary of the final stressed syllable.

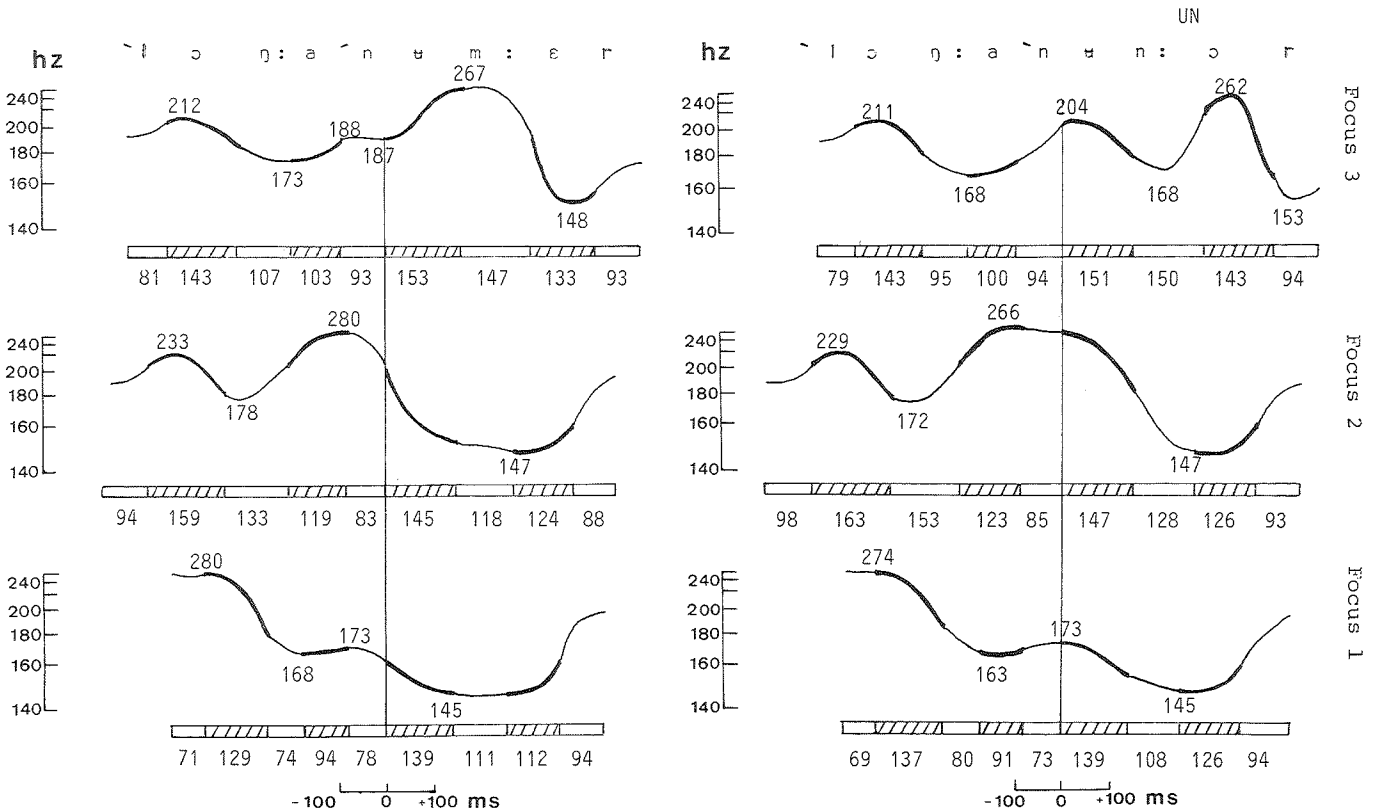

Figure 3. The effect of the placement of sentence accent and choice of word accent. Speaker UN. Typical Fo-contours for two-word phrases in sentence final position. Mean values of 6 repetitions of Fo-peaks and valleys and segment durations.

accent 1-word ´nummer in focal and post-focal position.

According to hypothesis B (tonal-to-temporal) we would expect more lenghtening for an accent 2-word than for an accent 1-word in focus because of the more complex tonal pattern (cf. Figs. 2 and 3, upper part). This prediction is not supported by the data. We find approximately the same durations for accent 1 and accent 2. There are only marginal differences in duration. We would have expected a larger increase of the long consonant and also of the final vowel for the accent 2-word, as compared to the accent 1-word, with reference to the difference in tonal complexity there. These results contradict the findings by Öhman et al. (1979, p. 309) for a similar comparison.

For speaker EH there is a durational difference in the final vowel, which might be tied to the higher tonal demands in the accent 2-word. But comparing the post-focal version of ´nummer/`nunnor (cf. Figs. 2 and 3, medial part), where the Fo-difference for the final vowel is absent, approximately the same difference in duration for the final vowel is present. Therefore it is likely that the vowel difference [ɛ] versus [ɔ] is responsible for the longer duration of the final vowel in the accent 2-word.

The conclusion is then that the same temporal program is used in focus (for both speakers) for accent 1 and accent 2 in spite of the higher tonal demands for accent 2.

That a wider range of an Fo-change does not necessarily bring about longer durations is clearly evident in Figs. 2 and 3, showing the durations of `långa in post-focal (lower part) compared with pre-focal position (upper part). The much wider range of the Fo-fall (for both EH and UN) in post-focal than in pre-focal position is not accompanied by longer durations of the segments involved. In fact the durations are shorter in post-focal position.

For the two post-focal versions of ´nummer and `nunnor (Figs. 2 and 3, medial and lower part) there is a considerable difference in the Fo-range of the word accent fall. In spite of this clear Fo-difference, the increase in the segment durations of the version with a wider range is only marginal.

A case where tonal demands cannot explain temporal differences is exemplified in Figure 4. The temporal structure of the last portion /ʃaket/ of the compound is clearly different, if the secondary stress is on the penultimate or the ultimate syllable. In focal position (Fig 4, left

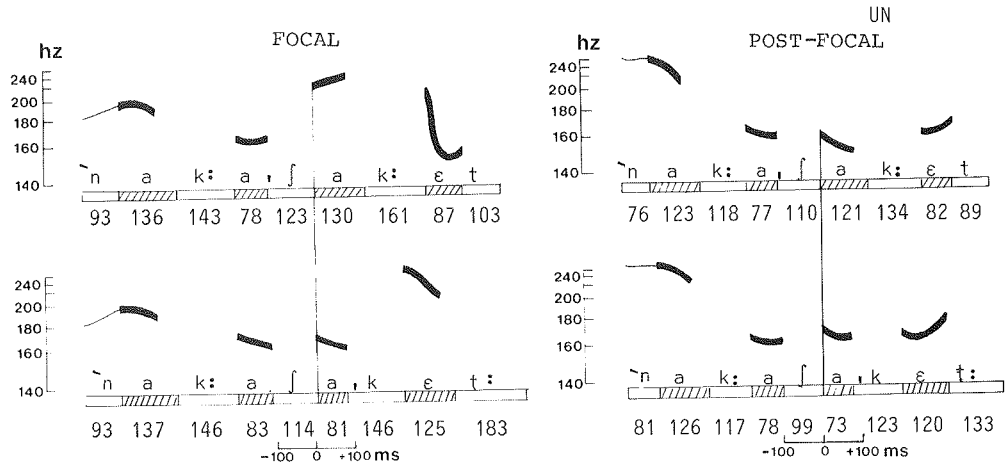

Figure 4. The effect of the placement of sentence accent. Speaker UN. Typical Fo-contours of compounds with varying placement of secondary stress. Mean values of 6 repetitions of segment durations.

column) the Fo-contours are distinct, but in post-focal position (Fig 4, right column) the Fo-contours are more or less identical. In this latter context the secondary stress placement appears to be signalled primarily by the difference in temporal structure (cf. Bruce 1977, p.14).

DISCUSSION

Erikson's paper (1973) on the synchronization of articulatory and phonatory processes cited as evidence for the temporal-to-tonal hypothesis showed a delay in the Fo-contour of the second syllable when the number of intervocalic consonants increases, and consequently the vowel onset of the second syllable is delayed as in words like ˋhingst,språng compared to ˋbi,hang. It should be noted that it is often the case - at least in running speech - that a heavy consonant cluster will be reduced, probably decreasing the duration of the cluster, e.g. [hiŋ:stspr ɔŋ:] pronounced as [hiŋ:spr ɔŋ:]. Although it is fully possible to retain the whole cluster even in running speech, the dropping of consonants is customary in heavy clusters, which may partly be due to the rhythmical constraints of a relative isochrony.

It is clear from this study, however, that the Fo-contour does not live its own life. The Fo-contour - or certain critical Fo-points - are crucially dependent on certain articulatory events. This point is probably agreed on even by those who advocate the tonal-to-temporal hypothesis (cf. Öhman et al. 1979, p. 310) and is not under debate. In this sense the temporal-to-tonal hypothesis is supported.

But it is still not clear , whether the realization of a complex tonal pattern can force Fo to make adaptations to the temporal program, or whether it will elicit a stretching of the segments involved, or some combination of both.

Comparing focal and non-focal position we find a more complex tonal pattern in focus. Normally we also find longer segment durations in focus. This is evident from Figure 5, which gives the durations for speaker UN for the phrase /slip:a nak:a skot:ɛn/. The Figure shows that all segments are being stretched in focus position. The increase is not confined to the segments - mainly the long consonant - where the sentence accent rise is found, although the increase appears to be larger here. This general increase may be interpreted as a direct contribution of focus to the temporal domain. i.e. perhaps both tonal and temporal changes are independent consequences of focus. Temporally this means that the focal part - the most informative part of an utterance - is simply given more time space.

As was noted above, the largest increase in duration for focus position is given to the long consonant of the stressed syllable. It has been pointed out that this is the segment where the sentence accent rise is usually executed, which lends support to the tonal-to-temporal hypothesis. But there is another possible explanation. In a study of the effect of sentence accent on quantity, Bannert (1979) has shown that it is the phonologically long segment of a stressed syllable that is given the largest increase in duration, i.e. the long vowel in a V:C-structure and the long consonant in a VC:-structure. This non-uniform increase in duration - the long segment increasing more than other segments - is expected for the following reason. If the quantity contrast is to be preserved, the durational differences must increase with increasing segment durations (cf. Bannert 1979, p. 256). Therefore the non-uniform increase of segment durations in focus can be accounted for without any reference to specific tonal demands. Moreover the tonal-to-temporal hypothesis cannot be used to explain the

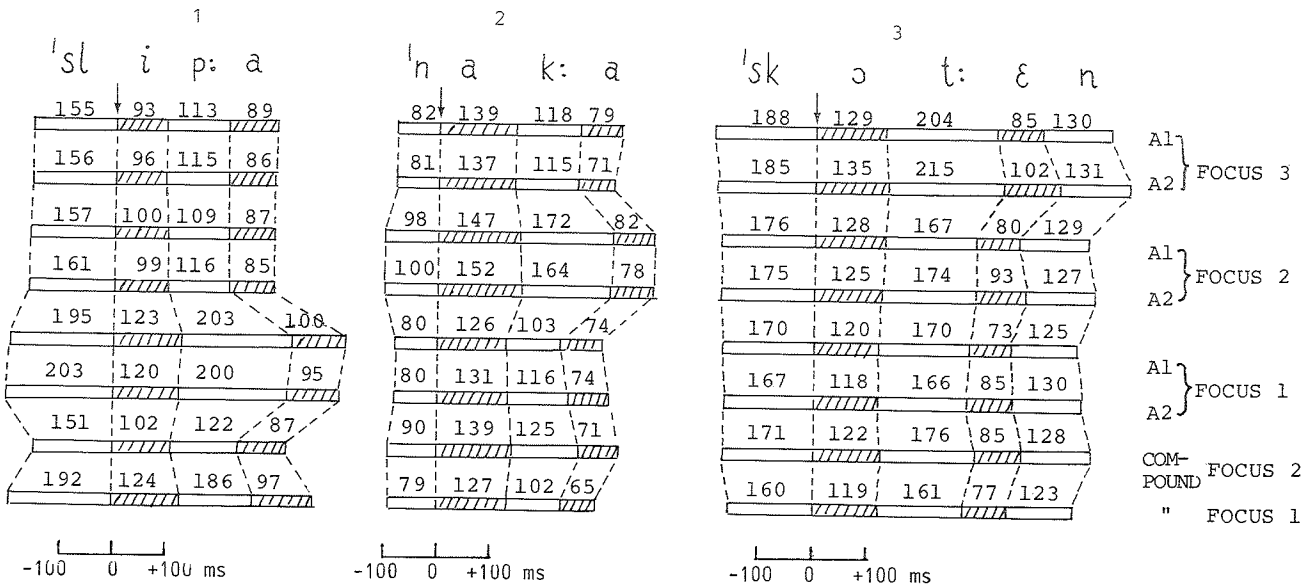

Figure 5. The effect of the placement of sentence accent, choice of word accent and phrase structure of the last part of the sentence (two-word phrase/compound). Speaker UN. Mean values of 10-13 repetitions of segment durations. Line-up points are at the CV-boundary of each stressed syllable.

extra increase of the long segment in a V:C-context, as the long vowel does not directly involve the tonal contribution of focus.

In a situation where focus and position in the sentence are kept constant and only word accent is varied, giving a more complex tonal pattern for the accent 2-word than for the accent 1-word, the temporal differences were shown to be minimal. If hypothesis B (tonal-to-temporal) were true, we would have expected a clear temporal difference between the two tonal contexts. With reference to the above discussion it can be concluded that the evidence for the tonal-to-temporal hypothesis in the present study is scarce.

It is of course possible that the actual temporal program for the focal portion of an utterance in Swedish "has been sculptured by the evolutionary forces of language use" (cf. Lindblom et al. 1976, p. 65). As there is usually a more complex tonal pattern in focal position, this may have contributed to longer durations for the focal portion than for non-focal portions of an utterance. This would mean that we are faced with a temporal preprogramming and not a moment-by-moment adjustment of the temporal program to the specific tonal demands, as has been suggested by Lyberg (1979, p. 196).

In order to arrive at a better understanding of the tonal and temporal interplay it is necessary to isolate the critical points of an Fo-contour and to examine their variability in time and frequency. In spite of the relative inertia of the laryngeal system compared to the supra-laryngeal system Fo appears to be relatively flexible in the execution of a complex tonal pattern. Interruption, anticipation and delay of Fo-changes are possible ways of coping with this kind of situation (see Bruce 1977, chapter 5). For example the terminal juncture fall occurs with a delay in the accent 2-word `nunnor in focus (Figs. 2 and 3, upper part) relative to the accent 1-word ´nummer. This flexibility of Fo makes it difficult to see how tonal demands could affect the segment durations to any considerable degree.

The results from the present study of tonal and temporal interplay in Standard Swedish indicate that there is a basic, temporal patterning which is independent of the tonal patterning. It has not been possible to confirm that this basic, temporal pattern is modified by certain tonal demands.

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OPTIMAL TEACHING OF SWEDISH PRONUNCIATION

Eva Gårding

Summary of a project
supported by the
Bank of Sweden Tercentenary Foundation.

This report completes our project, Optimal teaching of Swedish pronunciation (Optimering av svenskt uttal), which has been supported by the Bank of Sweden Tercentenary Foundation from 1.7.1976 to 31.12.1979.

The goal of the project was to improve the teaching of Swedish pronunciation to foreigners.

In the last two decades Sweden has had a large influx of immigrants. By now, of every hundred people living here, ten have a language other than Swedish as their mother tongue. Many of them speak Swedish with a foreign accent, which hampers communication and may be a serious social handicap.

Immigrants settling in Sweden are entitled to a course of 240 hours of Swedish during which they receive their regular pay. All this activity has brought about a number of excellent teaching materials, often based on contrastive analyses of Swedish and some of the most well-represented immigrant languages. The phonetic part of these analyses, however, have centered on speech sounds and sound systems, and the characteristics of continuous speech, in particular prosody, i.e. rhythm and intonation, have been neglected. In fact, teaching of pronunciation has often been confined to correction of isolated

items, so-called teacher's shibboleths, like [ŋg] for [ŋ] as in *mĺnga* and [ʏ] for [ʉ] as in *hus*.

In the project description we used the concept of optimization because we wanted teachers to make optimal use of the time allotted to pronunciation. Here are some examples of the questions we asked:

> What are the most important features in an acceptable Swedish pronunciation?
> What is the interference from the primary language, not only in speech sounds but also in syllabic structure and prosodic features?
> How do these features impair understanding?
> How are these features avoided?
> What are the causal relations between different features of a foreign accent?

It has been known for a long time that phonetic features appear in hierarchies. For instance, if the nasal consonant /ŋ/ occurs in a language, the consonant /n/ also occurs. We have found that this applies also to errors of pronunciation. They tend to occur in structured bundles, an important fact for optimization.

Work on the project has been reported in Praktisk Lingvistik (PL) 1, 3 and 5. It consists of the following major parts.

1. Collection of data

We have recorded samples of Swedish spoken by representatives of major immigrant groups and of languages whose phonology differs from Swedish in an interesting way. For each speaker there are several kinds of recorded materials, spontaneous speech, readings of texts, etc. The recordings are stored in what we call *The accent archives* (brytningsarkivet), housed at the Department of Linguistics and Phonetics at Lund University.

At present the archives contain speech samples from 25 languages. The publications are accompanied by cassettes which contain illustrative speech samples from the archives.

It should be noted that the data could be used for studies of other components of a foreign accent as well, e.g. studies of morphology, syntax and semantics.

2. Error analysis

Statistically important errors for a special group of foreigners are classified as rules violating the Swedish phonological system. These errors are presented in diagrams as variations from the target vowels and consonants of Swedish and from the target components of the prosodic system (PL 5).

3. Evaluation of errors

Hypotheses on the severity of errors from a listener's point of view were formed. In our evaluation we were not only concerned with code errors but also with psycholinguistic aspects of speech. To master the units of the code, the phonemes, is not enough. Timing, syllabification and accentuation are important cues to the listener and should conform to Swedish patterns (PL 1).

For pedagogical purposes, errors can be put into two main categories, *major* and *minor* ones (PL 5). A major error would be to speak Swedish without differentiating long and short vowels. This violates not only the code but also the syllabic structure of Swedish and therefore disrupts an important element of the rhythm. An example of a minor error would be to pronounce /y/ for /u/ in e.g. *hus*.

Some experiments have been conducted in order to give this view a firm basis. Manipulated stimuli have been made (using the program developed at the Phonetics Institute in Uppsala) in which an input signal of broken Swedish has been corrected for

rhythm and intonation. So far these stimuli have not been formally tested, but they are useful as illustrations of the importance of prosody in the teaching of pronunciation. (PL 1, p 68 and ff and Tape 1)

4. Error syndromes

Groups of cooccurring error types have been established and checked against data from the archives. Very often, these suggested syndromes are contradicted by the data but we have been able to confirm a number of them. For instance, devoicing of voiced obstruents after voiceless obstruents is connected with aspiration. Negative as well as positive evidence may be of pedagogical interest. There are certain close associations in the minds of teachers that have to be broken. For example, teachers who are speakers of Swedish or other Germanic languages tend to associate long syllables with stressed ones, but this association is not true for all languages.

5. Case studies

Teachers of Swedish as a foreign language often want to know about special 'tricks' that can be helpful in the teaching of pronunciation. This was one of the reasons why Robert Bannert and Gösta Bruce conducted some case studies using audio-visual feedback to study and correct articulatory gestures. This activity attracted many customers but only a few could be served (PL 1).

Results from our project work (1-5 above) have made it possible to describe and explain difficulties that foreigners of different linguistic background encounter in Swedish, to suggest pratical remedies, to show how to order pronunciation exercises and how to integrate them with other parts of the language course (PL 5).

Our work may also be of interest for phonological theory. In fact, our recorded material is a wealth of information for any

phonologist looking for natural correlates of phonological features and universal and language specific characteristics of language.

Organization and economy

Robert Bannert, who was a fulltime research assistant for the project from 1976.07.01 to 1979.12.31 was the only person who was paid for his work by project funds. Gösta Bruce assisted in the case studies, and I acted as consultant and editor. Secretarial aid was given by Isabel Alvarez and Lena Svensson, both paid by AMS (Swedish Board of Employment). The Department of Linguistics housed us and gave us access to the equipment of the Phonetics Laboratory. A Voicescope was provided by a grant from Lund University. Staffan Zetterlund and Sven Öhman, Uppsala, helped us with some of the experiments.

Project reports

Praktisk lingvistik nr 1	First edition	1000
	Second edition	700
Parktisk lingvistik nr 3	First edition	1500
Praktisk lingvistik nr 5	First edition	1500

These reports were sold at a moderate price. As a rule the proceeds from one number covered the production costs of the following number.

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A PRESENTATION OF THE LUND MODEL FOR SWEDISH INTONATION

Eva Gårding & Gösta Bruce

The aim of this paper is threefold, to give a brief review of a generative model for Swedish intonation which has been developed in Lund (Bruce & Gårding 1978, Gårding 1979), to introduce a few modifications and finally to give some general comments on its scope and nature.

The model originated from a study of fundamental frequency (Fo) curves in an extensive material representing four Swedish dialects. Its purpose is to generate such curves using only a few linguistically relevant parameters.

Model

The following two pages, which were a handout at the symposium, summarize the model. It consists of a linguistic part, an algorithmic part and a collection of prescriptions and conventions. The linguistic variables are word accents (WA), sentence accent (SA) or focus, and sentence intonation. The prototypes of the dialects are Malmö (South), Dalarna (Central), Stockholm (East) and Göteborg (West).

The accents, word accents as well as sentence accent, are represented by high and low points which will become turning points in the generated curves. The location of these points is determined by the dialect. Stockholm, for instance, has a HIGH in the preaccented syllable for A1 and a LOW in the accented one. Malmö, on the other hand, has a HIGH in the accented syllable, and a LOW in the postaccented one.

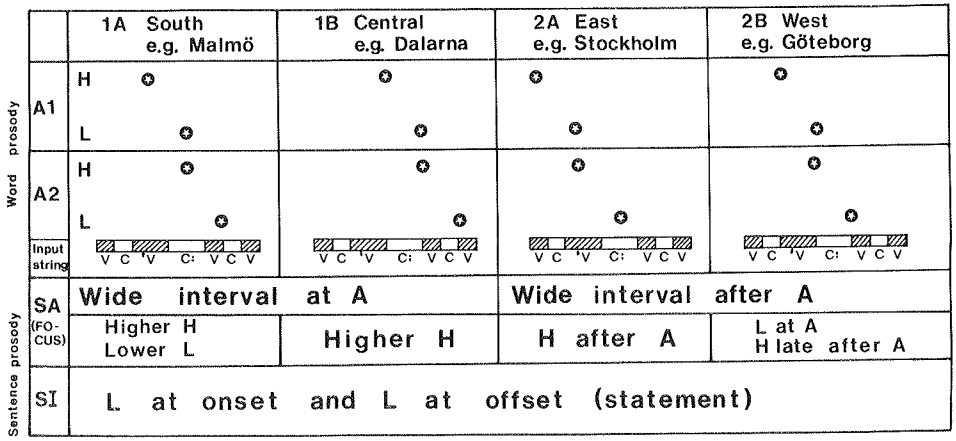
Common to all the dialects is that Accent 2 comes later than Accent 1 and that sentence accent is manifested as a large pitch interval.

The algorithm is a set of rules, the order of which is motivated by practical considerations. A later rule is not permitted to disturb the result of a rule applied earlier. The first

Swedish intonation model

Linguistic components

Dialectal representations



Prescriptions and conventions

Auxiliary lines expressing sentence intonation

Topline and baseline are approximately straight lines. The topline connects successive F_0 maxima outside the focus of a phrase. It starts and ends with the phrase. Its slope depends on the length of the phrase and the initial and final frequencies. These vary with sentence intonation but are otherwise rather constant depending on the individual speaker's pitch range. The baseline connecting successive F_0 minima is specified correspondingly. Focal lines connect focal maxima or minima in different sentence positions. These lines are nearly horizontal.

Conventions applying to the rules

WA Highs and Lows are on baseline and topline.

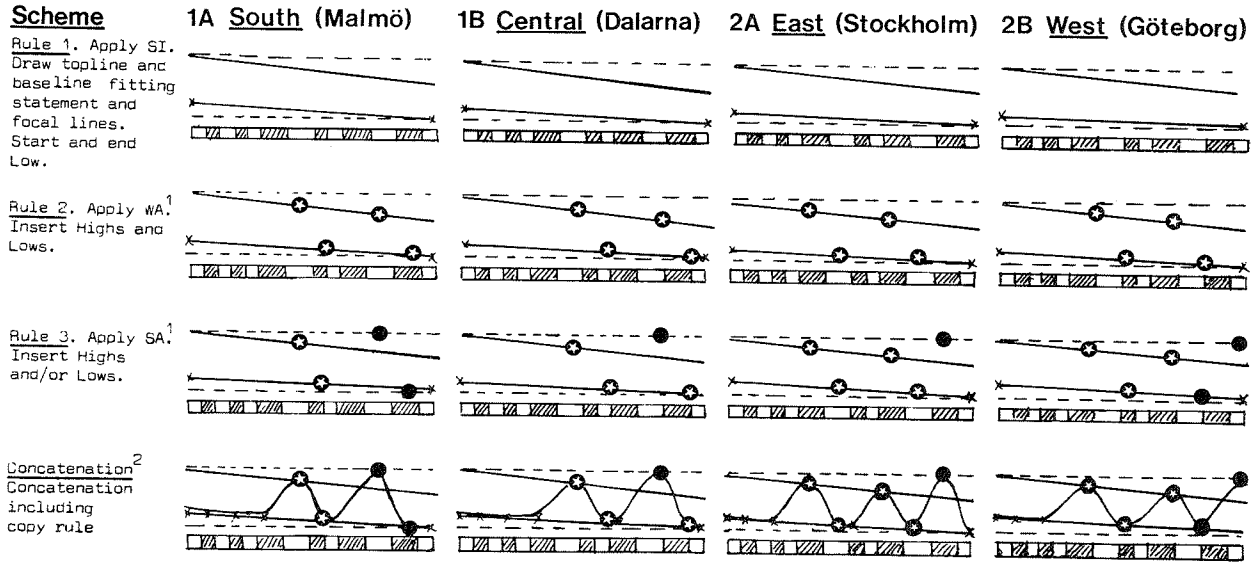
SA Highs and Lows are on focal line.

Example of an adjustment rule: If WA Low and SA High occur in final syllable, give priority to SA High.

Concatenation including copy rule: Copy the High and Low of a syllable onto the auxiliary line of the following syllable if nothing else is indicated. Join neighbouring points by straight lines.

Application of pitch rules

Example of input phrase: [nɔra lɔŋ:a nɛn:ɔr] Statement (A2 A2 SA)



1) here the adjustment rules are applied (See conventions)

2) See conventions

rule generates the frame of the sentence intonation. It consists of two interior slanting lines, i.e., a topline connecting the pitch peaks and a baseline connecting the pitch valleys of the accents outside focus. There are in addition two exterior hatched lines on which the HIGHS and the LOWS of sentence accent lie. These four lines give position-dependent pitch values to the HIGHS and LOWS of the accents. A statement like the example given in the algorithm is characterized by a global fall giving decreasing pitch values to the word accent HIGHS as well as the LOWS. The second rule inserts the word accents and the third rule the sentence accent. At the last stage a concatenation rule connects neighbouring points by straight lines.

With this model we can simulate observed pitch curves from different dialects in an acceptable way, as we have shown by LPC-synthesis carried out in Uppsala (Bruce & Gårding 1978). For the synthesis we used a carrier phrase made up of segments which do not differ very much across the dialects. Prosodically it is also very well suited to our purposes since it contains both accents, including A2 in a polysyllabic compound and unaccented syllables between the accented ones to show the maximal effect of the concatenation rule. (For different dialectal manifestations of compounds, see our other contribution to the proceedings.) The phrase was Man anammar lundamodellerna (A1 A2) 'One accepts the Lund models'.

Clarifications and modifications

The concatenation procedure as well as other dialect independent conventions are described under prescriptions and conventions.

Here we should like to make two clarifications.

The first concerns the domain of the baseline/topline construction. Recent work on text intonation in English (Lehiste 1975) and in Finland Swedish (Enkvist and Nordström 1978) suggests that the domain of intonation can be wider than the phrase or the sentence.

This has been confirmed also for South Swedish (Bruce, in press). Paragraphs consisting of two or three sentences are kept together by intonation, i.e. there is a successive downdrift in pitch covering the whole paragraph. The beginning of a new paragraph, e.g. a topic shift, appears to be signalled by a new downdrift from a reset pitch level.

A natural conclusion is therefore that the domain of the baseline/topline construction is at least the paragraph or the text unit.

The second comment concerns the range between the initial and final frequencies of a text unit. For a given intonation type we have assumed a constant Fo-range between the starting point and the end point irrespective of the length of the unit. This implies that the slope of the Fo-contour varies with the length of the text unit.

Recently Lehiste (1975) for English and Thorsen (1979) for Danish have shown that the range is not constant but increases with an increasing length of the unit.

In material containing text units with a varying number of stress-groups (Bruce, in press) it was found that for South Swedish the Fo-range between the starting point and the end point of each unit is practically constant, although the Fo-range between the first and the last accented syllable appears to increase with an increasing number of stress-groups. Some data that we have collected recently make us believe that although the range between the initial and final frequency appears to be constant, the topline and the baseline are not necessarily straight lines as indicated by our model.

Scope and nature

We shall finally comment on some linguistic and phonetic principles that the model is based on and discuss its applicability and limitations.

The model is based on a linguistic analysis which separates word prosody from sentence prosody. This is reflected in the

generative scheme. In this scheme sentence intonation comes first and gives the frame within which the word prosodic part can develop. The sentence accent, focus, breaks the frame by widening the pitch interval.

Linguistically the HIGHS and LOWS of our model, suggest an intonation system made up of four discrete pitch levels.

Since our analyzed sentences consist of sonorant segments only, we can regard the turning points of the pitch curves as indications of changes in the signals to the muscles which control features of tone and accent. Given the positions on the time and frequency axes of these turning points we can derive the full intonation curve. This is reflected by the concatenation rule. To make the algorithm applicable to other segmental contexts as well, a certain amount of readjustment will be needed (gaps for the voiceless consonants will have to be inserted, local falls before voiced obstruents due to loss of transglottal pressure will be introduced etc.).

The position of a HIGH-LOW relative to an accented syllable varies from dialect to dialect. The model takes this into account but it should be borne in mind that such a shift may change a tone movement involving an accented syllable to its opposite, which of course gives a totally different perceptual impression. It could be argued, then, that our model is production oriented rather than perception oriented.

The model is general in so far as it can generate intonation for a large part of the Swedish language area. Dialectal specifications seem to be needed only for one of the word accents. From this we can derive the other word accent and for most of the dialects also the sentence accent. We have regarded the global expression of sentence intonation as common to all the dialects.

Our model is a tool by which we can compare not only the intonation of different Swedish dialects but also the intonation of other languages. It can also be used to study prosodic interference between different dialects and between a primary

language and a secondary language (see our other contribution to this symposium).

Until recently we have concentrated on isolated phrases which have been elicited in a fixed situational frame. We started with statements and questions, the most firmly established types in the intonational system of a language, and varied the situations in such a way that the speaker was forced to focus various parts of the test sentence. Our next concern is intonation in a larger context. Such work is now underway.

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TRANSITIONAL FORMS AND THEIR POSITION IN A PROSODIC TYPOLOGY FOR SWEDISH DIALECTS

Eva Gårding, Gösta Bruce and Ursula Willstedt

We shall now report on how the model is used to describe tonal dialects that lie in between the four dialectal types which represent the main categories in the original typology (cf. Gårding 1975, Bruce & Gårding 1978). To collect a representative sample of such dialects two journeys were made, one in Skåne and Småland to record dialects between 1A and 2A, the other in Skåne and Halland to record dialects between 1A and 2B.

The test sentences were similar in principle to the ones that had been used in earlier work (Bruce 1977), i.e. sentences consisting of sonorant segments and three accented syllables. Words with Accent 1 and Accent 2 were represented in the material and Accent 2 occurred both in simple words and in compounds. Test sentences were elicited in such a way that the informant was forced to place the sentence accent in one of three possible positions.

A typical test sentence is "Man vill ˋ1lämna nåra ˋ2långa ˋ3nunnor" where the numbers indicate sentence accent locations.

The speakers were high school students and the recordings were made at some of the schools that serve as educational centers for the neighbouring countryside (for procedure see Willstedt 1980).

Småland

Figure 1 shows some examples of pitch curves derived from our Småland material, surrounded by the prototype for the 2A area, Stockholm, above and by the 1A area prototype, Malmö, below. The speakers are from Växjö, Väckelsång and Möckeln (see map, Fig. 5). The superimposed curves in each cell are derived from sentences with two accented words, the solid line representing a test sentence with the last word in focus, the dotted line a comparable sentence with the first accented word in focus. The column to the left contains the Accent 1 words. In the middle

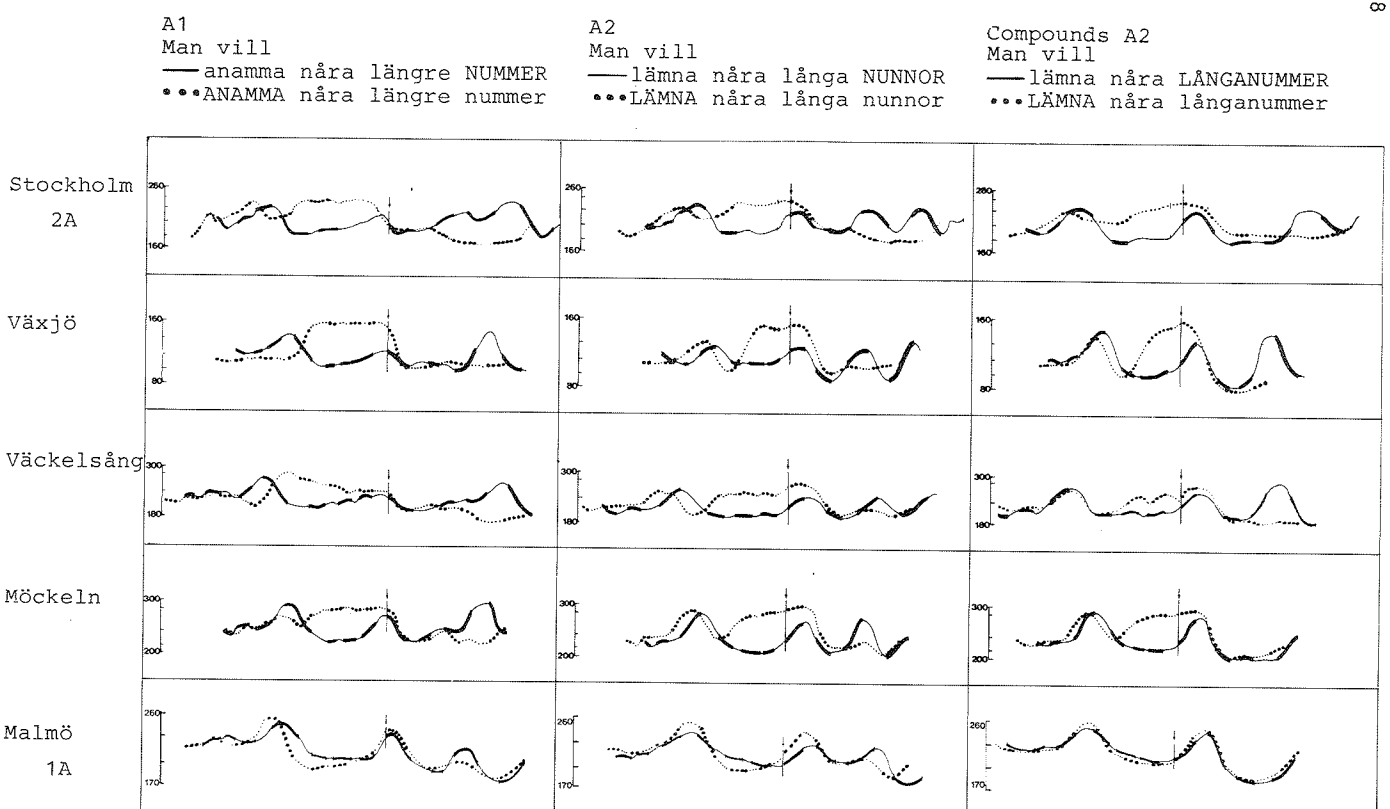

Figure 1. Intonation in Småland surrounded by prototypes 2A and 1A

we have sentences with simple Accent 2 words and in the column to the right the last word of the test sentence is a compound with Accent 2. As a rule the unusual test words called for some explanation and practice before the recording took place. The word anamma seemed to be obsolete in the sense of 'accept' for the great majority of the younger generation who only knew it as a curse jävlar anamma 'the devil take you'.

The figure shows even on casual examination that the Småland curves are more like the prototype from Stockholm than the one from Malmö. Or, expressed in the terms of the model:

The sentence accent, focus, is manifested as a HIGH which in an Accent 2 word comes after the accented syllable as in Stockholm. When this HIGH is connected to the postfocal HIGH, (cf. last rule of model) a plateau is formed which is characteristic also of the Stockholm contour. The Skåne contours, on the other hand, have only a large interval in connection with the sentence accent, which extends to the lowest pitch level. The postfocal accent peak has a lower peak value, which gives the characteristic slanting topline of a statement in this dialect.

Figure 2 expresses the relation between the Småland and Stockholm intonations in an interesting way. Schematic normalized pitch curves from both dialects have been superimposed on a common time axis where the segmental durations have been averaged over the dialects. Stockholm is the solid curve, Växjö the dotted one.

It is clear from the figure that the Småland contour is translated in time as compared to the Stockholm contour. Everything comes a little later in Småland, about 100 milliseconds. But this small translation in time may have a rather large perceptual effect. The Accent 2 word lämna in initial focus is a case in point. In Stockholm it is located in a falling - rising pitch but in Växjö in a rising - falling pitch movement which makes it similar to the Göteborg dialect (cf. Fig. 2). In the Småland material we have found a prosodic dialect which is different from our earlier prototypes. For the time being we call

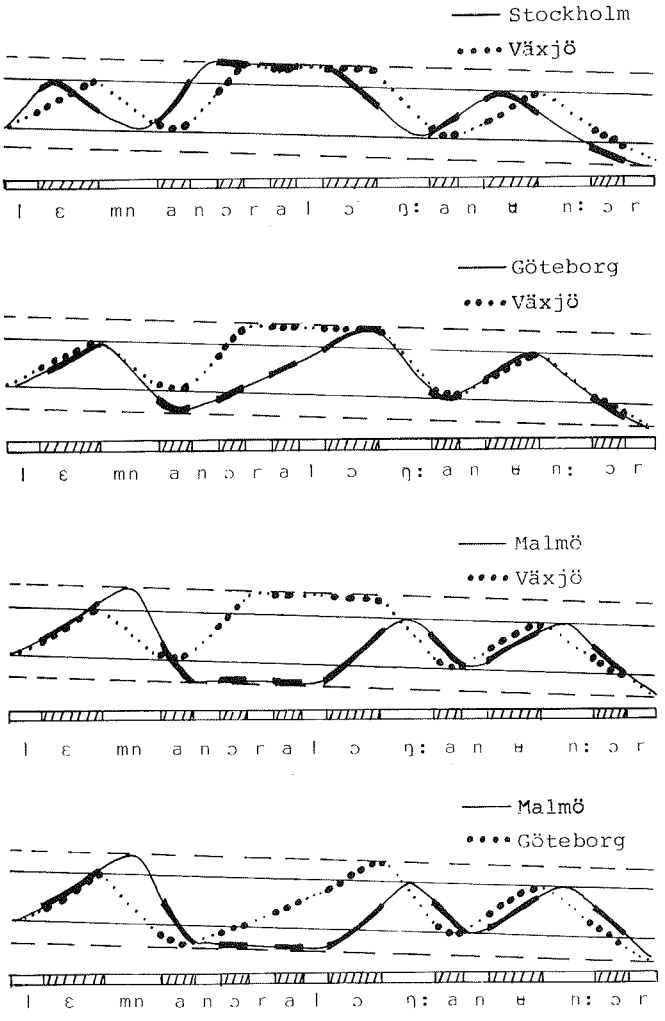

Figure 2. Dialectal comparison of test sentence LÄMNA nåra långa nunnor normalized for pitch and duration

it 2AB. The number 2 is used because the dialect has sentence accent manifested as a HIGH after the accented syllable for Accent 2 and thereby gets two-peaked A2 words in focus. A is used because the sentence accent in non final position resembles Stockholm, 2A, B because sentence accent in final position and the word accents resemble Göteborg, 2B.

Halland

Figure 3 shows in the same way as the previous figure for Småland, the Halland intonation, surrounded by our 2B prototype at the top and our 1A dialect at the bottom. In these examples the Göteborg intonation seems to become more like Malmö as we go from north to south. In Göteborg and particularly in Varberg the broad sentence accent interval is manifested between an extra low point in the focal accent and an extra high point, which occurs in the postfocal accent if there is one, otherwise in the final upglide which is so characteristic of the Göteborg dialect. The solid curves in Figure 4, an enlargement of Figure 3, show an interesting phenomenon. If we draw a topline connecting the last accent peak in focus with the end point of the curve we get a local rise for Varberg, a level line for Göteborg, Falkenberg and Steninge and a fall for Holm (outside Halmstad) and Malmö.

There are two conclusions that can be drawn. This local rise, may be mainly responsible for perceived differences between the southern 1A dialects and the western 2B dialects. Further, these dialects do not change in the same direction from north to south: level in Göteborg, rising in Varberg, back to level in Falkenberg and Steninge. But once the southern intonation type with the falling topline has been established north of Halmstad there is no return to the non-falling intonation pattern.

Figure 3 gives a somewhat simplified view of the Halland dialects. The map in Figure 5 gives a more realistic dialectal picture. The three symbols used in the map show that we have found three different prosodic intonation types, 2B as in

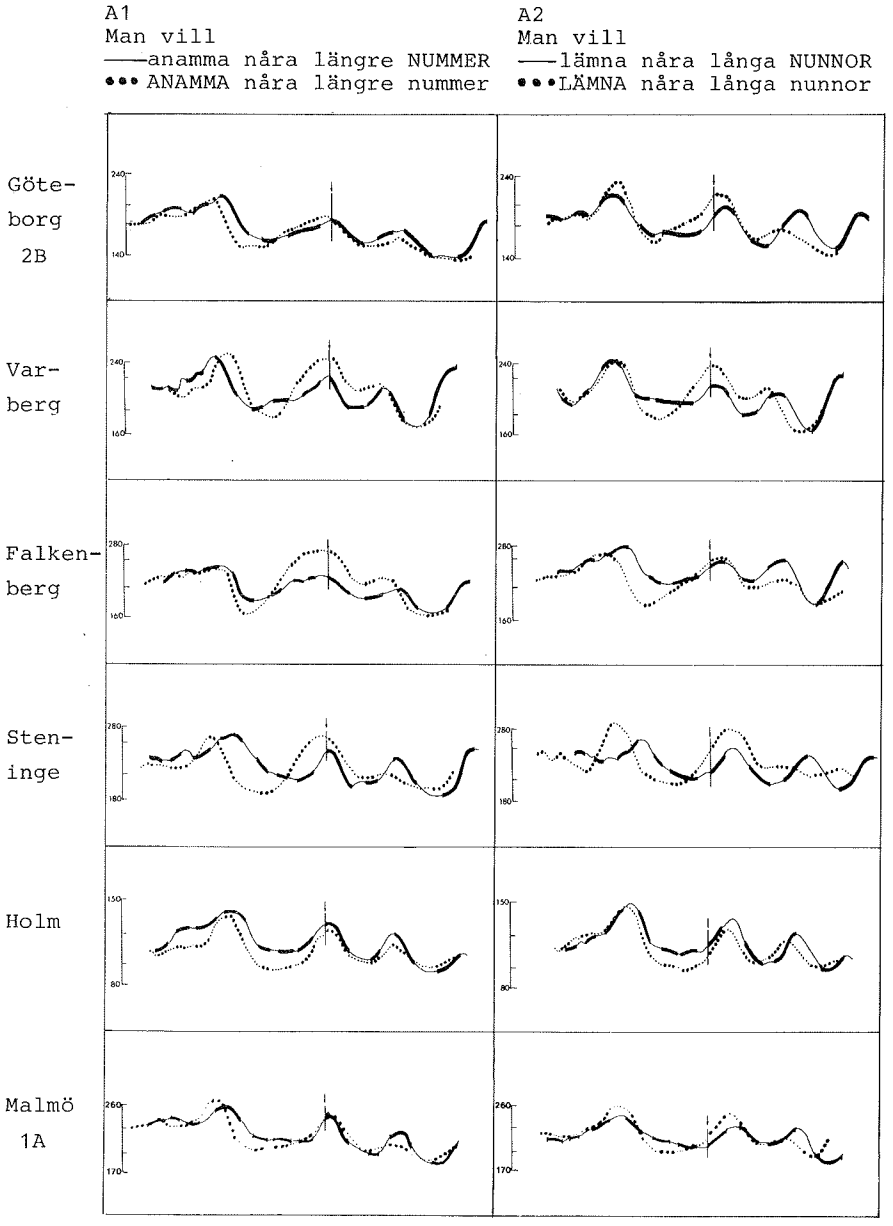

Figure 3. Intonation in Halland surrounded by prototypes 2B and 1A

••••Man vill LÄMNA nåra långa nunnor
——Man vill lämna nåra långa NUNNOR
----Topline (see 'Prescriptions and Conventions' in Bruce & Gårding, this volume)

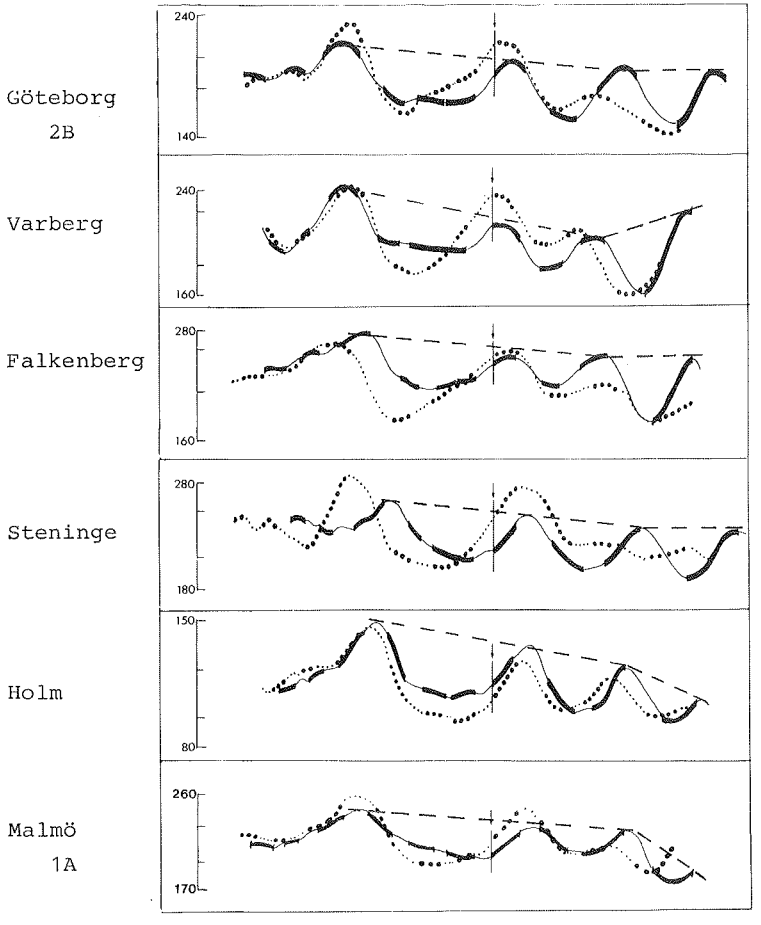

Figure 4. Toplines in comparable pitch curves from dialects between prototypes 2B and 1A

Göteborg, 2AB as in Småland and 1A as in Skåne. The distribution between these prosodic dialect types seems to agree with dialect borders based on the distribution of lexical and morphological criteria. According to Wessén (1970), for instance, there is a dialectal border at Falkenberg, a place where we have found both Göteborg intonation and Småland intonation.

Deviations from the prototypes

We shall now study deviations from the prototypes.

1. The whole contour has been translated in time in comparison with the prototype.

In the Småland 2AB dialects, the Lessebo pattern (Fig. 1) is translated in the direction of Stockholm and Väckelsång in the direction of Skåne.

2. Special rules are needed.

As can be seen in Figure 1 the Småland 2AB dialects treat compounds differently. In one group of Småland dialects represented by Växjö and Väckelsång in Figure 1, the compound has a rise in the first syllable of the last element, here nummer, a syllable which is traditionally ascribed secondary stress. Another group of dialects, here represented by Möckeln, have no rise in the corresponding syllable and are therefore much more like the Malmö or Göteborg compounds.

This means that the dialect specific rules need a special section for compounds (as for distribution, cf. Bruce 1973). It also means, which is perhaps more interesting, that the compounds may have played a special role in the development of the Swedish prosodic system (Gårding & Lindblad 1973).

3. Alternations.

In some of the Småland dialects (Möckeln, Växjö) there is a variation common to several speakers, namely in sentence accent in connection with Accent 1 in all positions. This brings to mind the old discussion of Accent 1 as being the unmarked case and hence more prone to variation. What happens is that a Stockholm pattern (early rise) varies with a Småland one (late rise). This indicates that the translation in time from the central Swedish pattern to the Småland one has perhaps not

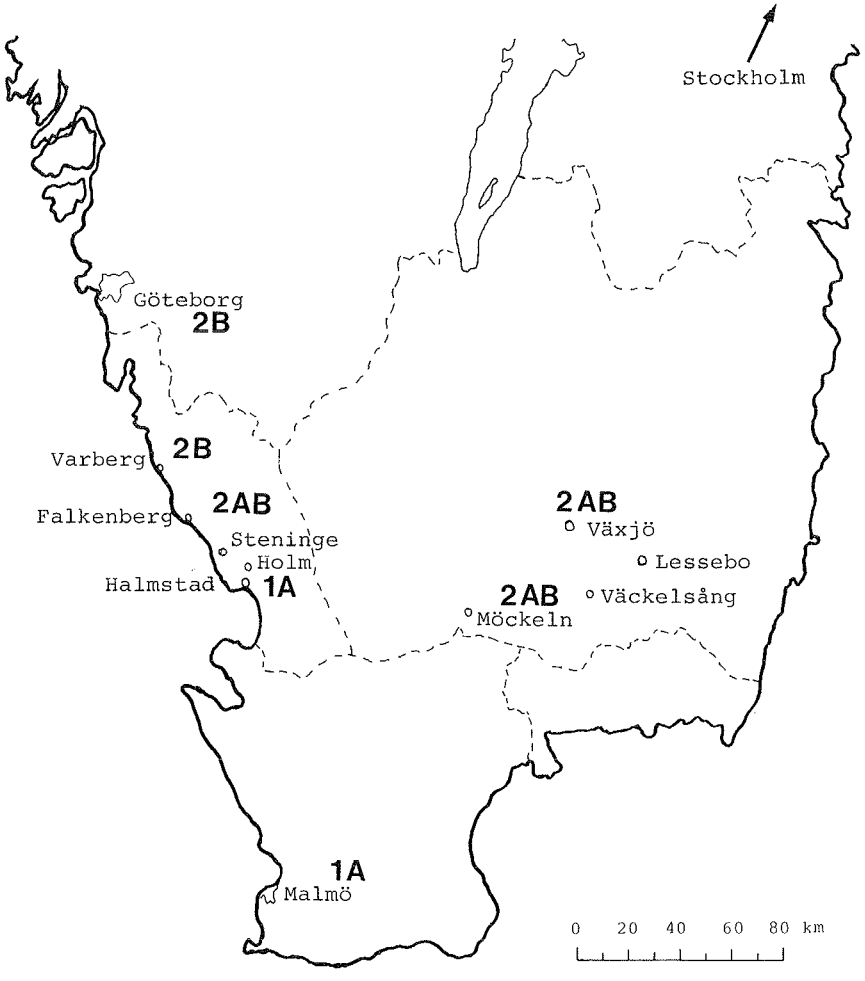

Figure 5. Distribution of prosodic dialect types in southern Sweden

necessarily been gradual, as the neat figure would suggest. Rather the translation may occur in the following way: Two patterns compete freely for a time, then one of them takes the upper hand. Or perhaps both of them remain but with different stylistic or pragmatic functions.

Conclusions

With all this new material, what happened to the model and its prototypes. Are they sufficient? Perhaps not. We have found dialects where the intonation pattern has been translated in time to such a degree that e.g. the perceptual tonal impression of an Accent 2 word in focus is drastically changed. A new type which we call 2AB seems to be motivated.

Are the rules and the generative scheme sufficient? Yes, largely. We knew from studying Kock (1878) and also because of Bruce's results that the distribution rules for compounds differed according to dialect, but we did not know that there were different manifestation rules for A2 compounds in otherwise similar Småland dialects.

Although the word accent timing may be more important than we thought earlier, the salient point of the old model, the sentence accent, remains. The kernel area of the intonation contour is the focal word plus the succeeding tone movement towards a following accent peak or the end of the sentence. We believe, but it remains to be tested, that the most important rules of the model are those that generate exactly this part of the contours.

And finally the classical question: Is the transition between two prosodic dialectal areas continuous? Or in other words: Does the transition occur in small steps or in some other way, perhaps by alternations in particularly vulnerable positions in the contour.

Figure 2 shows how difficult this question is. Schematic intonation contours of the prototype in the sentence lämna nåra långa nunnor are inserted on a common time axis with the same

segmental durations in all the dialects. The figure shows that a continuous transition is phonetically and phonologically easier to imagine between some dialects than between others.

We shall just give one example here. The Skåne pattern (with higher focal than postfocal peak) can become a Steninge pattern by raising the postfocal peak. This pattern can become a Varberg or Göteborg pattern by lowering the focal peak. Such a transition, then, can occur in small steps, which suggests that there is a closer relation between the southern 1A and Western 2B dialects than we thought earlier. But other examples in our material, notably those from Småland, suggest that the transition may have been preceded by a stage with alternations and that the final focus position may be more exposed to change than other positions. And in Växjö we have found alternations which are quite independent of position.

The answer to the question of continuity will then be: Sometimes perhaps, but sometimes certainly not.

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ON FINNISH PLOSIVES

Lea-Liisa Lahti

INTRODUCTION

The voice onset time has been used in several studies as a measure for comparing different series of plosives: voiced, voiceless and aspirated. The purpose of this paper is to study Finnish plosives and compare the results with other data.

Lisker and Abramson (1971) find that voiceless unaspirated plosives are very common in languages. Finnish has only one series of plosives, voiceless unaspirated. There is an opposition between /t/ and /d/ in medial position, but it is fairly marginal. Thus the plosives in Finnish follow the tendency in languages, which should be reflected in a very short voice onset time (nearly Ø). This is tested in this investigation.

PROCEDURE

Subjects

In this investigation a group of 5 Finnish male students studying at the University of Lund were used as informants. All of them speak Standard Finnish without any strong dialectal colouring. They come from the southern or southwestern part of Finland.

Speech samples

Four disyllabic words were embedded in a frame sentence *Sanopa... .....toistamiseen/uudestaan*. The choice of the last word was determined by the final segment of the test word, so that *toistamiseen* followed after a vowel, *uudestaan* after a consonant. The test words occupy a position in which they receive the sentence stress. The stress in Finnish words lies on the first syllable. To minimize coarticulatory effects the adjacent segment was always /a/.
Three of the words have an initial plosive /p, t, k/ and the

V O T msec	p-	t-	k-
KR	9	14	28
JS	12	10	20
JN	8	16	24
JP	8	10	28
EE	12	12	36
mean=	9.8	12.4	27.2
n=	5	5	5
S=	2.61	5.93	10.04

Grand average = 16.47 msec
n = 15
S = 8.72 msec

Table 1. The voice onset time of the Finnish voiceless plosives (in msec).

fourth has a medial /d/, the only position that /d/ can have in Finnish words. These cases cover the whole inventory of Finnish plosives. The test sentences were randomized within a list of 30 sentences. The informants were instructed to read the whole list three times in a normal, unemphatic way.

Experimental equipment

The recordings took place in an acoustically treated room at the Phonetics Laboratory of the Department of Linguistics, Lund University, using a unidirectional microphone and a high quality tape recorder. The frequency response of the tape recorder was flat within ±2 dB, from 30 Hz to 14000 Hz. The signal to noise ratio was 63 dB.
The appropriate input level was adjusted for each informant. The tape speed was 19 cm/sec.
The test material was analyzed on a PV-10 Voiceprint sound spectrograph.

Acoustic analysis

The voice onset times (VOT) of the plosives were measured by

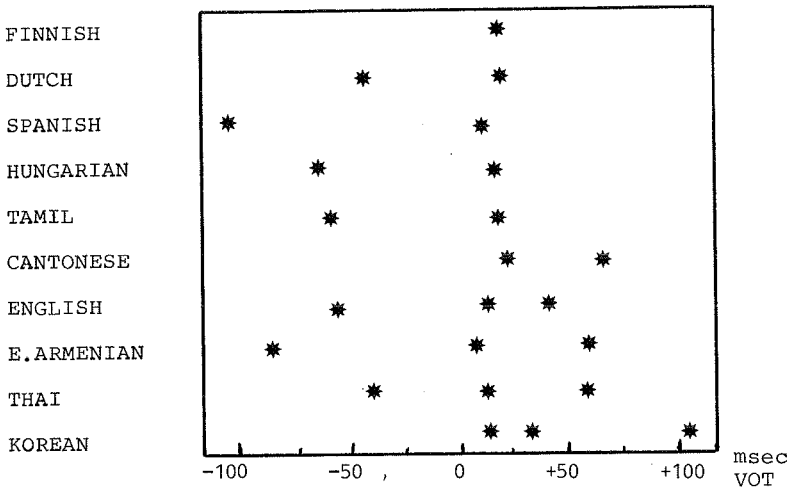

Table 2 Mean VOT of Finnish stops in wordinitial position compared to mean VOT of stops in sentence initial position, after Lisker & Abramson (1971).

hand on the wideband spectrograms of the test sentences according to the procedures used by Lisker and Abramson (1971), i.e. the time interval from the release of the plosive to the onset of glottal vibration in the following vowel. The words analyzed were: *pata*, *taka*, *kapat*, *sadan*. Mean VOT values and standard deviations were calculated in milliseconds.

RESULTS

The results for the voiceless plosives are presented in Table 1. The average VOT was shortest for /p/ and longest for /k/. As a whole, the Finnish voiceless plosives have an average VOT of 16.5 msec (S= 8.72).
We leave /d/ out of consideration, because it can only occur in medial position. It gave an average of -30.4 msec (S= 10.04).

DISCUSSION

These results can be compared with those presented by Karl Suomi (1980):

	p	t	k	
K.S.	9	11	20	msec VOT
L.L.	9.8	12.4	27.2	

and note that they agree with each other.
If we place the grand average of the Finnish voiceless unaspirated plosives on the scale presented by Lisker and Abramson (1971), we can see that it lies very close to the zero point compared to the other nine languages on the scale, all representing languages with two or three series of plosives (Table 2), thus supporting the hypothesis.
We can speculate as to the reason for the short VOT in Finnish. The short voice onset time and brief burst are the result of the timing of the laryngeal and the supraglottal activities, the vocal folds being adducted immediately after the release of the stop. One can find a similar tendency towards short VOTs in child language, retarded speech, aphasic speech, dysarthry and other speech pathologies (Macken & Barton, 1980; Blumstein et al., 1977; Lehiste, 1965). These similarities suggest that the voiceless unaspirated plosives can be regarded as the primary unmarked group of plosives and that this type can be expected in languages with only one series of stops.
The Finnish plosives raise problems in language teaching not only when a series of voiced plosives is to be learnt (e.g. in Finland Swedish), but also when the voiceless plosives of the target language have both aspirated and unaspirated allophones (e.g. Swedish, English etc.). Suomi (1980) has discussed the problems caused by the system of Finnish plosives when teaching English to Finnish speaking persons. When teaching languages with an even more complicated system of plosives to Finnish speaking persons there is probably a short-cut to mastering the distinctions. Effective practice in aspirating the voiceless series rather than special training in voicing the voiced plo-

sives gives better results in keeping these series apart. This has been tried with success.

This investigation will serve as a pilot study for a larger scale investigation of interference from Finnish on the Swedish spoken by Finns.

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SLIPS OF THE TONGUE, SLIPS OF THE PEN - SLIPS OF THE BRAIN?

Kerstin Nauclér and Ewa Söderpalm

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of Applied Linguistics, Montreal, 21-26 August 1978.

The student of speech errors - slips of the tongue and of the pen - is certainly entering a borderland in the search for evidence of speech and language organisation in the brain. Since the turn of the century there has been a growing interest in this field where students of clinical and experimental psychology, linguistics, neurology and speech pathology meet to put questions and hopefully have them answered.

The best known slip - but hardly the most frequent one - is an error with a transposition of elements. This kind of error is also referred to as "spoonerism", named after William Spooner, a warden of New College at Oxford, who was said to have a special talent for making this kind of slip. Many spoonerisms have now become classical like "my queer old dean" instead of "my dear old queen" and "work is the curse of the drinking classes" for "drink is the curse of the working classes". Whether William Spooner actually uttered these lapses or they were constructed by his students is a different matter.

Other kinds of errors are those with one segment anticipated, perseverated or only substituted. (Fig.1.)

Although speech lapses have been used for humorous reasons in the literature for a long time, a more serious study began in the last century. In 1895 a collection of about 9000 speech errors was published by Meringer who carefully classified the lapses and also provided plenty of information about the speakers. Meringer's way of interviewing the speakers about themselves and their lapses is said to have made him the most unpopular person at the university of Vienna. With this in mind

METATHESIS

pan cakes — can pakes

ANTICIPATION

cup of coffee-cuf of coffee

PERSEVERATION

he took the pen-he took the ten

SUBSTITUTION

transformation-transpormation

Fig.1. Types of errors

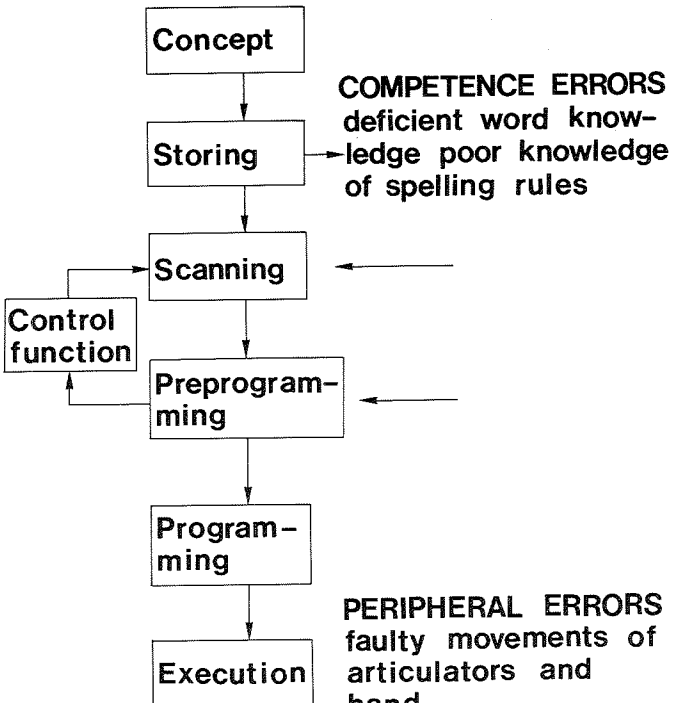


Fig.2. Model for error generation

modern scolars have used more moderate methods in collecting their data.

Meringer's extensive collection has provided data for many researchers with an interest in speech errors. Freud studied Meringer's corpus to gain insight into psychological repressions. MacKay has made a statistical analysis of Meringer's data, only to mention a few names.

Many studies of errors have aimed at classification only. Others have been carried out with the purpose of shedding light on linguistic performance and speech production. Fromkin's name is wellknown in the field. Recently, the interest seems to have changed from naturalistic studies to laboratory experiments, e.g. instead of collecting errors occuring in spontaneous speech, errors are elicited in highly controlled contexts.

The number of studies of written lapses is sparse. In Merringer's enormous collection of speech errors, a small amount of writing errors is included. About two decades later, Stoll reported a classification of errors in handwriting made by subjects who were copying texts. After that very few investigations have, to the best of our knowledge, been carried out in this field.

MacNeilage studied typing errors as clues to serial ordering mechanisms, which he found sensitive to certain structures such as word boundary, length of word, position in word etc. No phonetic phenomena were apparent among these errors. Lecours classified all errors found in the diary of one male subject with developmental dysgraphia.

Errors in the motor program for handwriting have been analysed by van Nes. His interpretation of the errors applies to the form of the letters only, and the similarity of the shaping movements is regarded as the triggering factor. The aforementioned investigations have looked upon writing errors from a pure temporo-spatial motor programming point of view. No linguistic factors have been described except for in the study of typing errors by MacNeilage.

When deviant linguistic performance is investigated (e.g. error

analysis of second language learning) the aim is to obtain better understanding of the normal way of performing. As is well known, investigations of aphasic speech have increased the insight into the nature of normal speech.

The present study describes and compares Swedish lapses of three kinds namely

slips of the pen
slips of the tongue and
aphasic speech errors.

Although slips are normal phenomena in both speech and writing they must be regarded as abnormal in the sense of being deviations from the intention of the speaker or writer (and probably from the expectations of the listener and the reader too). Whether aphasic errors are deviations from the speaker's intention is still an open question.

The similarities between aphasic errors and slips of the tongue are stressed by many scolars. Our clinical impression, however, is that the errors are similar in many respects but that there are also great differences. Therefore, a comparison between the normal and the pathological samples is carried out.

By investigating slips of the tongue and slips of the pen it will be possible to compare the two types and draw conclusions as to the processes common to linguistic behaviour irrespective of mode of expression. A deeper understanding of the rules underlying normal and deviant performance will

1. Contribute to better therapeutic work among aphasic patiens and
2. Facilitate the work of reading teachers by increasing the knowledge of writing behaviour

It has already become apparent that we regard a slip, whether spoken or written, much in the sense of Boomer and Laver, i.e. as an involuntary deviation from what the speaker or writer has in mind. By this definition no competence errors are included, i.e. errors resulting from deficient word knowledge and, in writing, from poor knowledge of spelling rules. We also exclude

errors due to faulty movements of the articulators (slurring)and of the hand (scrawling).

In our preliminary model (Fig.2) units are fed forward into the scanning box. After scanning the units go on to the next box for preprogramming. Before the program continues, a control function is activated. Errors treated in this study emanate from the scanning and the preprogramming boxes. Only phonemic errors are discussed.

The slips of the tongue made by normal adult speakers were collected over a period of some years. They all occured in spontaneous speech. No reading errors were included and no errors made by persons who have Swedish as their second language. The errors were immediately written down and if possible confirmed by other listeners and the speaker.

The pathological speech sample was collected in therapy sessions, in naming tasks and in free conversation with adult aphasic patients. The errors were written down immediately and often recorded on tape. The patients were all examined by a team of medical doctors and speech pathologists. No restrictions were made in choice of patients based on the etiology of the brain lesion. Thus, patients with aphasia due to cerebrovascular accidents (CVA) and tumours are represented in the material. The mental state of the patients was normal. No attempts were made in this study to differentiate between different sites of brain lesions as it can be assumed that phonological errors are characteristic of aphasic speech as such, regardless of type of aphasia. This assumption is supported by the work done by Blumstein in Boston.

Articulatory difficulties of patients with aphasia might superficially look very similar. Nevertheless there are several varieties with totally different origins. A sharp distinction between the different kinds is sometimes very difficult to make, especially in those cases where they coexist. It is however of utmost importance for the rehabilitation programs that the disturbances are carefully diagnosed and that the articulatory difficulties are characterized as dysarthric, apraxic or phone-

mic disorders.

Dysarthria represents a defect in the *execution* of speech movements. Apraxia represents a defect in the *encoding* of articulatory gestures. Dysarthric speech is slurred and imprecise. Apraxic speech is usually very laborious. Dysarthric and apraxic errors were not included in this study. Only phonemic disorder, so called literal paraphasias were studied. The patients with paraphasias have no motor difficulties but limited access to the correct sensory representation. The speech is usually fairly fluent but the awareness of the errors is low.

The slips of the pen were collected together with other errors found in 150 essays written by Swedish students aged 18-19 years. In addition, a similar corpus from younger students was collected twice at an interval of two years in order to compare the influence and interaction of different linguistic rules in speech and writing at different levels of education. All errors were divided into three categories

1. Spelling errors, caused by deficient knowledge of spelling rules
2. Lexical errors, emanating from incorrect interpretation of the meaning or the origin of a morpheme, and
3. Slips of the pen.

The classification of the errors is a delicate task, since the different types are easily confused. For instance, a slip of the pen may happen to look exactly like a spelling error or a lexical error.

Furthermore, a fourth group has to be recognized and separated from the others, e.g. the graphic errors. They arise in the motor program as an interaction of letters of similar shape, resulting for instance in an upstroke instead of a downstroke.

No rules for categorizing a certain error can be given in advance. The whole writing sample of the student must be considered. An error might be regarded as a slip of the pen in the production of one student but as a lexical or a spelling error in the production of another, depending on what the rest of the errors

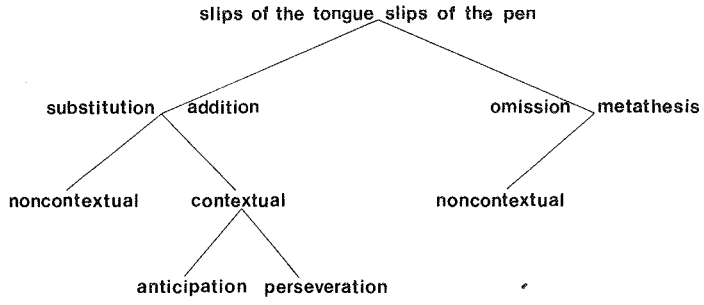


Fig.3. Classification

look like. A *p* written instead of a *b* is not likely to be a graphic error if the same student also writes *k* instead of *g* or *f* instead of *v*.

In this paper the only errors to be discussed are the slips of the pen from the corpus of the older students. Since the essays in question were part of an important examination task they have no doubt been rigorously gone through by their authours. Thus, the remaining slips are the only ones not noticed and corrected in proofreading.

Although slips of the pen occur at different levels, only phonemic errors will be considered here.

The total amount of errors in speech and writing together is around 400. There are several possibilities for describing and classifying spoken and written slips. One way is to compare the slip with the target and describe the difference as either a substitution, an addition, an omission or a metathesis (Fig.3). Instead of a bare

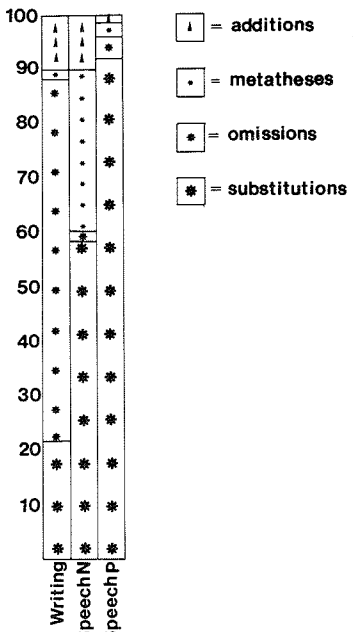
description it might be more interesting to look for the triggering factor of the error and make a classification on the basis of contextual and non-contextual triggers. The contextually or syntagmatically conditioned slips can be either anticipations, i.e. a segment is uttered or written earlier than intended, or perseverations, i.e. uttered or written later than intended.

The first graph shows the classification of the errors into the four categories, substitutions, additions, omissions and metatheses, from our three different samples. It is obvious that the categories are far from equally distributed in the three samples. Substitutions make the main category in speech, covering 59% of normal and 92% of pathological speech. In writing, substitutions amount to 22% only. The main category in writing consists of omissions, constituting 61% of the slips of the pen, compared with 4% in pathological and 1% in normal speech.

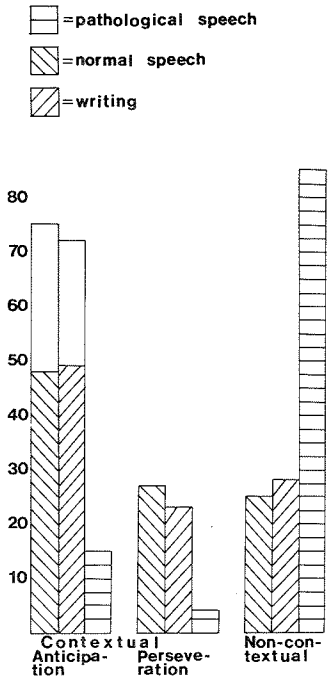
Another clear difference to be seen is the category of metathesis which amounts to 1/4 of the errors in normal speech but only a negligible part of pathological speech and writing.

As was mentioned earlier, errors can be triggered either contextually or non-contextually. With a trigger in the context, errors can be regarded as either anticipations or perseverations. The division of substitutions and additions into contextually and non-contextually triggered errors can be seen in Graph 2. The difference between pathological speech on one side and normal speech and writing on the other is obvious. As many as 85% of the errors of aphasics are non-contextual, while those of the normal speakers and writers are contextual in about 70-75%. The anticipation-to-perseveration ratio is about 2:1 for both normal speech and writing. The number of contextual slips from the pathological sample is too small to permit any calculations as to this ratio. The predominance of anticipations suggests a common tendency of "planning ahead" in normal speech and writing.

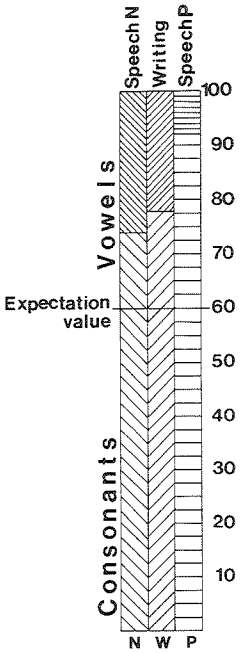
Consonants are more often involved in errors than vowels and more often than should be expected from frequency of occurrence in Swedish. It can be seen from Graph 3 that consonants consti-



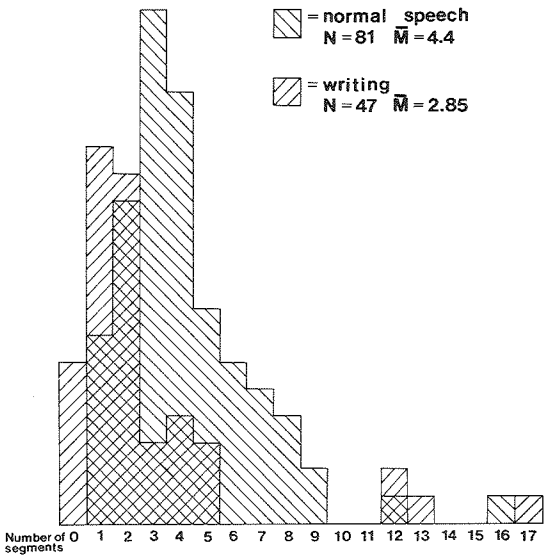
Graph 1. Distribution of categories in speech and writing.



Graph 2. Contextual and non-contextual errors in speech and writing.



Graph 3. Distdistribution of consonants and vowels.



Graph 4. Distances between trigger and error in normal speech and writing

tute 74% of the errors in normal speech, 79% in writing and 92% in patholoical speech. The proportion of consonants in continuous speech and writing in Swedish is around 60%. Cohen (1966) and Nooteboom (1969) reported 67% and 69% respectively of consonants involved in slips of the tongue in Dutch.
The distance between trigger and error is supposed to provide a clue as to the size and amount of units programmed at the same time. We have measured the distance by counting the number of intermediate segments -phonemes- for both speech and writing. The mean distance between slip and trigger is 4.4 segments in normal speech (N=61), 2.85 segments in writing (N=47) and 2.4 segments in pathological speech (N=10), where the number of items is too small to be considered further. The difference between mean values of normal speech and writing is statistically significant at the 95% confidence level, measured by two sample t-test.

The frequency of intermediate segments is shown in Graph 4 for normal speech and writing. It is evident from the graph that the most frequent number of intermediate segments is 1 and 2 in writing and 3 and 4 in speech. The majority of the substituted segments differ from the intended ones by one single feature. The features most frequently substituted are place and voice. Very few substituted segments differ from the intended one by more than two features. This is true for both speech and writing. This finding is in accordance with results from studies of other languages (Fromkin 1971).

Some of the results obtained in this study are similar for speech and writing, som are different and some of them indicate separate behaviour in normal speech and writing on the one hand and pathological speech on the other. We believe that the variations in distribution of categories, i.e. the different frequencies of substitutions, additions, omissions and metatheses can be explained with reference to mode of expression, while the similarities can be seen as evidence of a common linguistic planning function for speech and writing.

The majority of the errors made by the pathological speakers reflect poor access to linguistic units. The errors are non-contextual, e.g. paradigmatic mistakes prevail. The speaker's efforts to find the appropriate units are so time consuming that his possibilities for planning bigger chunks are strictly limited. Therefore, few errors are contextual and few are sequential e.g. there are few metatheses and the distance between error and trigger is short. Also in writing the distance is shorter than in normal speech. We regard this as an indication of the writer's adaptation of the processing speed, due to his slower mode of expression. Writing also differs from normal speech in permitting the author to control his writing over and over again and discover an error before it is discovered by the reader. This extra opportunity for correction is likely to reduce the number of slips of the pen, but at the same time the listener is much more generous than the reader by disregarding many omissions. What is regarded as an error in writing might well be overlooked or even permitted in speech. This is a possible explanation for the great difference between speech and writing as to the number of omissions. The opportunity for proofreading might explain the small number of substitutions in writing. It is not contradictory to what is known about the strategy of fluent readers that incomplete information is more easily overlooked than faulty information. Thus, substitutions are often corrected, while omissions often remain undiscovered even in proofreading, perhaps partly due to the fact that omissions occur in positions where the redundancy is high. The hypothesis put forward in the title of this paper suggesting a common linguistic planning function for speech and writing is supported by the similarities found between slips of the tongue and slips of the pen. The high proportion of errors containing phonetically similar units is strong evidence of the linguistic origin of errors in speech and writing. This resemblance quite excludes a graphic explanation of slips of the pen. The common tendency in speech and writing to substitute a single phonological feature is another evidence of the linguistic rather than the peripheral nature of slips of the tongue. The tendency to plan ahead is the same

in both speech and writing, with a higher proportion of anticipations than of perseverations.

This paper has emphasized similarities between lapses in writing and lapses in speaking that cannot be satisfactorially explained if the lapses are looked upon as peripheral, e.g. as real slips of the tongue and real slips of the hand. The similarities are evidence of linguistic mistakes occurring higher up in the programming chain - in the brain - and manifesting themselves in both writing and speaking.

However superficially similar, the differences between on the one hand lapses originating high up in the brain and on the other hand errors that are peripheral and channel-specific should be kept in mind, not only by speech pathologists but also by reading teachers as a means of developing more systematic methods of helping students with spelling problems. Since no writing rules can keep a student (or anyone else) from making slips, the teacher should rather concentrate his pedagogical efforts on spelling rules and vocabulary. Knowledge about what slips look like and in what contexts they most frequently occur will, however, enable the teacher to show his students how and where to proofread their writings more closely in order to discover their slips of the pen.

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PROSODIC FEATURES IN CONDUCTION APHASIA

Barbara Prohovnik

Abstract

Prosodic features (tonal and temporal) of the speech of two conduction aphasics were studied. Patients were compared to each other and to three normal speakers. All read a standard diagnostic text (Swedish version of The North Wind and the Sun). Compared to the normals, the patients paused more often, spoke more slowly and in shorter units (both as defined by pauses and as defined by intonation) and showed no evidence of medial shortening/final lengthening effects. Quantitatively, pausing was more deviant than differences in intonational patterning. Compared to each other, the patients differed with respect to pause frequency and sensitivity to syntactic structure as reflected in intonation patterns. It is suggested that prosodic features may be of value in differentially diagnosing patients within an aphasic syndrome, because prosodic differences may reflect different underlying defects.

Introduction

Several studies have shown that prosodic characteristics such as tempo and intonation are sufficient for broadly differentiating the main aphasic syndromes (Howes & Geschwind, 1964; Benson, 1967; Kerschensteiner et al., 1972; Wagenaar et al., 1975). Moreover, it is the patients classified as fluent according to prosodic characteristics who produce phonological and lexical jargon. Both of these facts highlight the importance of prosody for clinical diagnostic and therapeutic purposes, as well as for the theory of language production.

The study reported on here is based on the speech of two conduction aphasics. With respect to prosody, conduction aphasics are considered to lie somewhere between the extremes of prosodically normal, fluent (Wernicke's) aphasia and the non-fluent, dysprosodic speech of Broca's aphasics. Conduction aphasia typically involves segmental substitution and sequencing errors (called literal paraphasia) and/or a short-term verbal memory defect. It is identified clinically by the patient's inability to repeat despite good lexical comprehension (cf.Benson et al,1973;Shallice & Warrington,1977). The patients were chosen because they appeared to be good representatives of the two subtypes of conduction aphasia; Patient 1 had a predominance of segmental errors, and Patient 2 showed evidence of a short-term memory deficit, in addition to an initial segmental disorder.

The aim of the study was to see if prosodic characteristics could be useful in distinguishing patients within a major syndrome, and whether different prosodic features (i.e., tonal vs. temporal) are differentially affected in this type of aphasia.

Subjects[1]

Patient 1 (P1) was a 62-yr-old ambidextrous former bricklayer from southern Sweden, admitted in October 1972 with right hemiparesis and aphasia after a sudden fall. Three weeks after admission the patient was able to walk and use his right hand. His speech was extremely paraphasic, and he was not able to repeat even single words without gross distortions. Naming of objects was grossly paraphasic, but he was able to adequately demonstrate their use by means of gestures. There was some perseveration. The patient could point to named objects, and he could obey verbal commands to stick out his tongue, put his finger on his nose, whistle, and point to his ear, but with long latencies. Comprehension of normal conversation appeared to be fully intact, and tests of ability to identify non-verbal sounds showed no impairment. After five months of therapy there was some improvement in ability to read aloud single words, but spontaneous speech and repetition were still grossly paraphasic.

Patient 2 (P2) was a 62-yr-old former custodian from southern Sweden, with a history of hypertension. In March 1976 he was admitted for a few hours with a suspected transient ischemia with no paralysis, Babinski or headache. The following day he was readmitted, because relatives reported that he couldn't talk. On readmission he produced fluent jargon without much information content. There was no paralysis or dysarthria. He could not stick out his tongue on command, but could imitate the gesture. On initial speech examination, the patient's speech was paraphasic (both literal and verbal paraphasia) and he could not repeat any but the shortest words, and these only after many presentations by the therapist. He could not point to named pictures or follow written instructions, but he could match written words to pictures. Naming was paraphasic, writing to dictation extremely paragraphic. Paraphasias in speech decreased during the next few months and reading aloud was almost error-free, but even after a year of therapy the patient could neither repeat nor write phrases of more than two words. Spontaneous writing was paragraphic, but the patient was able to edit his writing so that the final production contained few errors. Comprehension was normal, apart from a word deafness, which persisted throughout 1 1/2 years of therapy.

Neither patient was able to produce serial speech (counting, days of the week, months) without error or perseveration. Both had some high frequency hearing loss, and both reported that they had never spent much time writing.

Three normal speakers were recorded for comparison. GH, a retired baker, age 73, had some hearing impairment and used a hearing aid. ID was a housewife, age 71. GB was a trained phonetician, age 31. All were from the same

regional dialect area.

Materials

All subjects read a Swedish version of The North Wind and the Sun. The patients were recorded during aphasia examinations: P1, 3 weeks after admission (P1:1), five months later (P1:2) and after about 16 months (P1:3); and P2, 12 days after admission (P2:1) and about 10 weeks later (P2:2). (some spontaneous speech was recorded for P1 at P1:2 and P1:3, and for P2 some time after P2:2).

The normal speakers were told to read as naturally as possible. GH and ID were not familiar with the text and were not given any opportunity for practice. GB was specifically instructed to read slowly, and he was very familiar with the text.

Duplex oscillograms with separate intensity and pitch curves were made for each reading. Segmentation was done manually, and the durations of silent pauses were measured. Prosodic phrases (roughly corresponding to tone units) were identified according to the relative pitch of stressed syllables (identified auditorily) and terminal junctures, using the pitch curves. Finally, durations of the four occurences of the words kappa/kappan (or their paraphasic substitutions) were measured, to allow an estimation of final lengthening/medial shortening effects.

Results

1. Segmental errors and self-corrections

Despite a superficial similarity, the two patients differed from one another in terms of the number and types of target-related errors they made. On the first readings, both P1 and P2 were paraphasic. P1's paraphasia did not improve over the three readings, and more than half of the target words he read were incorrect, sometimes distorted beyond recognition. P2 differed on his first reading in that he produced fewer errors than P1, in terms of incorrect targets, but many more repeated attempts (for 17% of the target words) for both correct and incorrect productions. By the second reading, however, (10 weeks later) P2 had only two target errors. Although the errors were quantitatively comparable to the normals, they were still recognizably pathological (så hårt att någonsin kunde, kappan onôm sig).

Table 1. Incorrect targets and repetitions as % total words in text.

	Patient 1			Patient 2		Normals		
	P1:1	P1:2	P1:3	P2:1	P2:2	GH	ID	GB
% incorrect	63	53	58	28	2	1	6	1
% repetitions/ self-corrections	4	0	0	17	0	1	1	0

2. Intonation

The major difference in sentence intonation between patients and normals was that the patients divided their utterances into more prosodic phrases than the normals. That is, sequences of stressed-word peaks which could be connected by a single downward-sloping topline in normal sentences were often composed of separate sequences, each with its own topline, in the aphasic sentences. Such f_0 resetting is seen both in patients and normals, but more frequently in the patients, as we would expect if the patients process speech in smaller, syntactically defined chunks.

However, when the patients were compared to each other, two differences emerged. The first is related to the difference in error types. The overall prosodic effect of P2's first production was more abnormal than that of any other reading, including P1's, because of the frequency of repetitions and self-corrections (and more frequent pausing, see below). As in normal speech, his repeated corrections are marked by a higher pitch than the words they replace.

The second difference concerns the stress level of function words. The only sentence stress abnormality for P2 (first reading), apart from the prosodically normal but too frequent stressed repetitions, is a focal stress on gång, shown in Fig. 1 below. P2's second reading was indistinguishable from the normal readings, with respect to sentence intonation. (Fig. 1 is normalized for duration; P2's first try was almost twice as long as the second.)

Fig. 1 also shows that there was a large register difference between P2's first and second readings. This is most probably due to a stress reaction, not uncommon in the initial period after a cerebro-vascular insult (Wilkins, 1963). This initial stress reaction may have contributed to P1's extremely high pause frequency in the first reading, as well.)

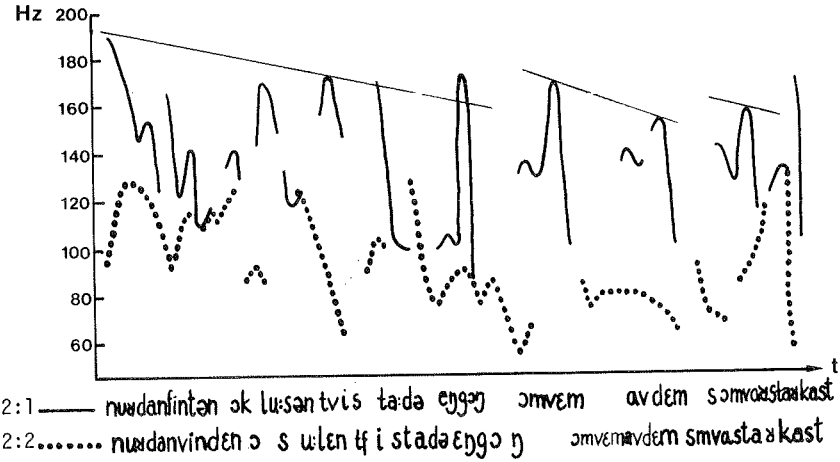

Fig. 1. Comparison of P2's first and second readings of sentence 1. Normalized durations.

In contrast to P2, P1 frequently begins prosodic phrases with stressed function words. Fig. 2 shows P1's production of sentence 2, compared to a normal reader (GH). Although both sentences contain two prosodic phrases, divided at the same juncture, in the normal reading the initial preposition i is unstressed, whereas for P1 it has a high pitch level. The same is true for P1's phrase-initial relative pronoun som in sentence 3, for men ('but'), the comparative adverb desto, and och ('and') in sentence 4, and och in sentence 5, in all three of his readings. The only phrase-initial function word which is not stressed is att (solen) 'that (the sun)' in sentence 5. Apparently it is the word's position in the prosodic phrase, rather than its lexico-syntactic status, which determines whether it will have a high pitch level or not: Virtually all of P1's prosodic phrases begin at a high f_0 level, but function words within prosodic phrases are appropriately destressed.

3. Rate

Both patients read at an abnormally slow rate, not only as measured in words per minute, which is affected by pausing,[2] but also as measured by syllables per second, excluding pause time. Even at the second recording P2's rate is slower than that of the normal reader (GB) instructed to read slowly.

Fig. 2. Comparison of normal (GH) and aphasic (Patient 1) production of sentence 2; phrase-initial function word stressed in Patient 1's production.

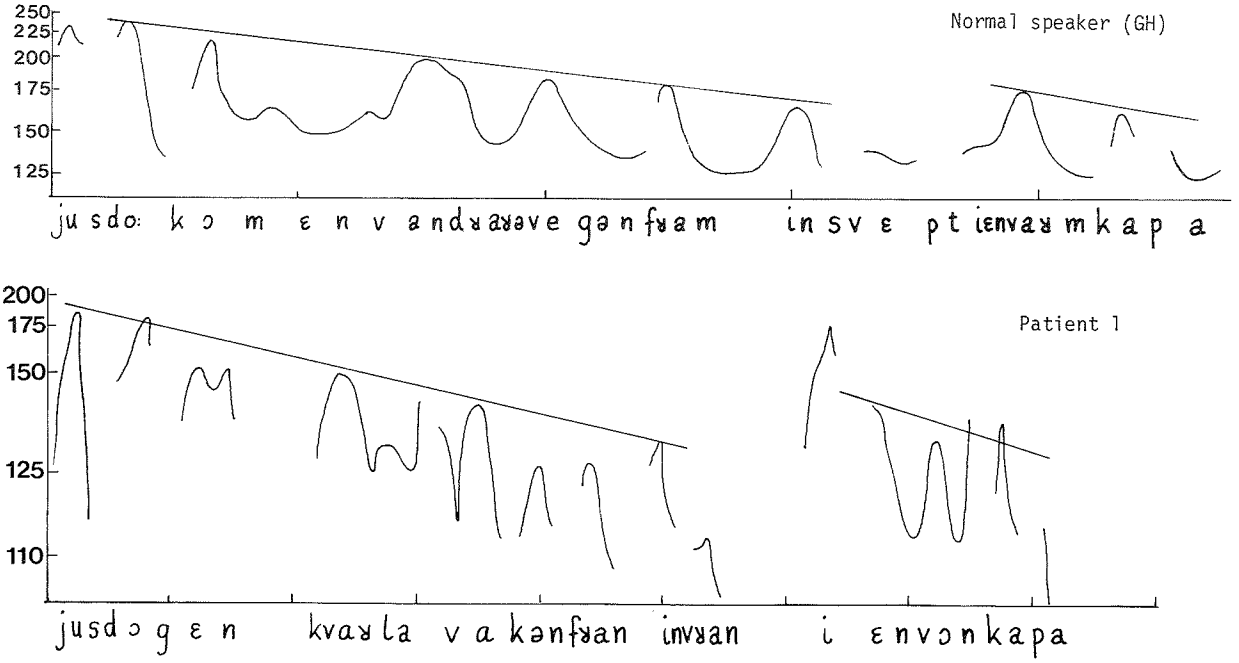

Table 2. Speaking rate in words per minute and syllables per second.

	Patient 1			Patient 2		Normals		
	P1:1	P1:2	P1:3	P1:1	P1:2	GH	ID	GB
wpm	70	65	70	43	91	114	120	104
syll/sec	2.47	2.23	2.12	2.01	2.92	4.09	4.17	3.10

4. Pausing

Not only do the aphasics break sentences up into shorter, intonationally defined prosodic phrases than the normals, but also, as expected, they pause more often between and within phrases. Table 3 shows the number of prosodic phrases, defined as a resetting of the stressed peak topline, compared to the number of word sequences bounded by pauses for each sentence and subject.

Table 3. Prosodic phrases/interpause sequences.

	Patient 1			Patient 2		Normals		
	P1:1	P1:2	P1:3	P2:1	P2:2	GH	ID	GB
Sent. 1	3/5	3/7	3/4	3/8	3/2	2/2	3/1	2/1
Sent. 2	5/6	2/6	2/5	4/9	2/2	2/1	2/2	2/2
Sent. 3	4/10	2/10	2/8	3/10	2/2	2/2	3/2	2/2
Sent. 4	7/14	5/16	5/16	10/30	3/10	3/5	3/4	3/4
Sent. 5	4/14	5/13	6/11	9/18	4/9	4/4	4/4	4/3

(excluding pauses under 100 msec duration)

Table 3 shows that pausing is quantitatively much more deviant than intonationally defined phrasing. In the paraphasic productions (excluding P2's "recovered" reading) 98.5% of the interpause sequences contain less than five words, and more than half include only two words or less. Only 12% of the normal interpause sequences are as short as four words. P2's performance, both with respect to prosodic phrases and number of pauses, improved dramatically. Although 70% of his interpause sequences still contain less than five words, the short sequences are almost all in the long, syntactically complex sentences 4 and 5. In contrast, P1's pauses are about equally distributed over all the sentences, regardless of length or complexity.

For both patients and normals, mean pause durations at major syntactic boundaries (sentence and clause) are greater than anywhere else.

5. Final lengthening/medial shortening

In normal speech, the relatively shorter duration of a pre-final as opposed to a clause-final word can be taken as evidence of temporal subordination of the words to a higher-level articulatory plan. If this is the correct explanation for medial shortening, it seems that the patients lack the ability to structure their productions in large enough units to produce the effect, since there is no evidence of medial shortening for the words measured; for them, final words were often shorter than the medial ones.

Table 4 shows mean durations for the three pre-final occurrences of the words kappa/kappan. (All but one (i.e., tɔpəld) of the ten paraphasic substitutions had the same syllable structure as the target words, and kappa was never shorter than both final occurrences of kappan in the normal readings). Final lengthening/medial shortening was evident for all three normals.

Table 4. Durations of clause-final and pre-final kappa/kappan, sec.

	Patient 1			Patient 2		Normals		
	P1:1	P1:2	P1:3	P2:1	P2:2	GH	ID	GB
Final (mean of 3)	.73	.80	.83	.82	.70	.60	.65	.64
Pre-final	.84	.80	.98	1.04	.88	.41	.48	.47

None of the normal pre-final words, and all of the aphasics' were followed by pauses. They ranged in duration from .08 - .4 sec.

Discussion

The data presented here confirm the clinical impression that conduction aphasia may have little effect on sentence intonation. Although more than half of Patient 1's target words contained segmental errors, pause durations and sentence intonation respected syntactic structure in all but the most complex sentences.

The overall prosodic effect of Patient 2's first (paraphasic) reading is more abnormal than that of Patient 1. This is clearly due to the frequent

repetitions and self-corrections which, in combination with the paraphasic errors, make the listener's task more difficult, since they require a suspension of interpretation until the patient finds the requisite word or accepts a paraphasic substitute for it. These repetitions and revisions add new prosodic phrases to the sentence, and the listener must recognize them as amendments and then backtrack to a previous phrase in order to follow. In normal speech, deviations from sentence intonation and rhythm can be used as markers of a change in the sentence plan, since false starts and self-corrections are relatively rare. Patient 2's revisions are so frequent, however, that such prosodic marking has tendencey to lose its signal value.

Paradoxically, Patient 1's lack of prosodically disruptive revisions is probably a symptom of a more severe aphasic impairment than that of Patient 2, as it suggests that Patient 1 was less able to attend to and correct his paraphasic errors.

Pause behavior also suggests that Patient 1's linguistic deficit was the more severe. The length of interpause sequences in Patient 1's and Patient 2's (first) readings did not appear to be affected by syntactic complexity, presumably because neither was able to scan large enough units. But when Patient 2 improved segmentally and prosodically, he paused less often in the syntactically simpler sentences than in the long complex ones. This suggests that pause frequencey may be useful as an indication of degree of syntactic impairment.

Both patients respected sentence boundaries, as shown by intonation and pause duration. However, Patient 1's stressing of phrase-initial function words, which were appropriately unstressed even in Patient 2's initial reading, implies that he was more impaired thant Patient 2 even from the onset. This difference in particular may mean that conduction aphasics with literal paraphasia as the most prominent symptom are more impaired syntactically than patients with a predominant short-term verbal memory defect. (Cf. Shallice & Warrington, 1977; Caramazza & Zurif, 1976.)

Finally, since Patient 2 showed difficulties with complex syntactic structure, as reflected in pause frequency in his second reading, and since neither patient showed any medial shortening/final lengthening effects, it is likely that some degree of syntactic impairment affected speech pro-

duction for both patients, even though intonation was fully normal in Patient 2.

Because of the limitations of the material and the restriction to two patients, the results presented here can only be considered suggestive. What they suggest, however, is that more detailed study of the finer detail of prosodic structure may be helpful in diagnosing linguistic impairment in aphasia, perhaps especially for patients who do not clearly fall into either of the fluent or non-fluent categories.

FOOTNOTES

1. I would like to thank Doc. Peter Kitzing and the staff of the Department of Phoniatrics, Malmö General Hospital, for making the tapes of the patients available to me, and speech therapists Catharina Anderson and Boris Larnert for taking time to discuss them. Of course the responsibility for the descriptions given here is mine.
2. Most studies of "normal" reading rates have used young, highly educated speakers and different texts. Johnson reported normal reading rates of from 105-219 wpm, and Darley from 129-222 (both cited in Williams et al., 1974). Grosjean & Collins call a mean of 201 wpm normal.Burns & Canter found a mean of 104.6 wpm for five conduction aphasics, compared to mean 155.2 wpm for five Wernicke's aphasics. Canter (1963) found a mean syllable duration of .16 sec. (=3.7 syll/sec.) for 17 Parkinson patients and also for 17 normal controls. In that experiment, normal reading rate ranged from 140-219 wpm.

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APPENDIX

The North Wind and the Sun (Nordanvinden och solen)

Nordanvinden och solen tvistade en gång om vem av dem som var starkast. Just då kom en vandrare vägen fram insvept i en varm kappa. De kom då överens om att den var starkast, som först kunde få vandraren att ta av sig kappan. Först blåste nordanvinden så hårt han någonsin kunde, men ju hårdare han blåste, desto tätare svepte vandraren kappan om sig, och till sist gav nordanvinden upp försöket. Då lät solen sina strålar skina, och genast tog vandraren av sig kappan, och så var nordanvinden tvungen att medge, att solen var den starkaste av de två.

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CURRENT RESEARCH PROJECTS

The immigrant and communication technology - understanding and being understood (The Bank of Sweden Tercentenary Fund)

Robert Bannert, Kenneth Hyltenstam, Gisela Håkansson

Verbal reforms (The Bank of Sweden Tercentenary Fund)

Bengt Sigurd, Christer Platzack, Anna Orrling

Dictionaries for immigrants (The National Board of Education)

Bengt Sigurd, Agneta Svalberg

Commentator, a computer system simulating verbal behaviour (The Council for Research in the Humanities and Social Sciences)

Bengt Sigurd, Lars-Åke Henningsson

Swedish Prosody (The Council for Research in the Humanities and Social Sciences)

Eva Gårding, Kerstin Tevajärvi

From Text to prosody, a pilot project (The Council for Planning and Coordination of Research)

Gösta Bruce

The aerodynamics of phonation (The Wallenberg Trust)

Anders Löfqvist (with Peter Kitzing and Björn Carlborg, Malmö General Hospital)

PRAKTISK LINGVISTIK

Nr 1-1979 Eva Gårding & Robert Bannert
Optimering av svenskt uttal
10:- (incl. cassette recording)

Nr 2-1979 Kenneth Hyltenstam (ed)
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