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INTONATION CONTOURS IN DIFFERENT REGISTERS
A pilot study.

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1. INTRODUCTION

The work presented here deals with how two different intonation contours, a statement and an engaged question, appear in different voice registers. The registers were obtained in two ways.
1. The intonation contours were produced by a man, a woman and a child, respectively, using their natural voice register.
2. Three different voice registers were produced by one person, an actress-singer (GK) using first her natural voice register and then a higher and a lower register, imitating a child's and a man's register, respectively.
In this paper we will concentrate on the natural registers used by the two women and the man for our two intonation contours. The results of the imitation will be presented later. In analysing the data, we addressed in particular the following question: Does a change from one register to another imply that all frequency values can be transposed by using a certain factor or is the transposition between different registers nonuniform?

2. PROCEDURE

The material used was a short SVO-sentence, Å mamma nannar Malla 'And mummy puts Malla (a girl's name) to bed' pronounced both as a statement and as an engaged question. Thus the sentence intonation is the only interrogative cue in the question.
The sentences were produced six to ten times by the two women and the man. The speakers were instructed to deliver focus-free productions. One of the women (KL) had some difficulty in producing focus-free questions. Examples of tracings of typical tonal curves, which are judged to represent the average case, are

shown in figure 1. Mean frequency values were calculated for tonal peaks, valleys, starting points and endpoints, see tables 1, 2 and 3. The mean frequency values are presented in a logarithmic scale in figures 2 and 3. The frequency values are plotted equidistant in the time domain. Successive medium-sized peaks are connected with a broken line, constituting the topline of the tonal grid. A baseline is drawn in a corresponding manner and the two lines obtained constitute the grid which encloses a major part of the tonal curve. See Gårding (1983) for a more thorough description of the tonal grid concept.

3. RESULTS

3.1 The effect of sentence intonation.

The declination of the grid lines represents a global fall of the tonal contours for all the statements. The questions are represented by rising grid lines except for one of the women (KL) who had some difficulty in producing this kind of question intonation. Still, there is a clear difference between her statement grid and her question grid. KL's global fall is much less pronounced for the question as compared with the statement and the frequency range between the topline and the baseline of the grid is markedly expanded in the question. A frequency range expansion of the grid in the questions can also be seen for the other persons.

3.2 The effect of register change.

A comparison between the male grid and the female ones displays a difference in the slope of the lines. The topline in the male grid has a steeper slope than the baseline, which makes the grid funnel-shaped. This is not the case for the two women where the topline and the baseline are approximately parallel. On the other hand, the male and female toplines have approximately the same slope. The distinguishing factor between male and female grids seems to be the different slopes of the baseline. These grid differences imply that register changes cannot be described by a simple transposition of the frequency values using a certain factor. Parallel grid lines have also been found for other female speakers of Swedish. A funnel-shaped grid is found for a Chinese male speaker (Jialu Zhang, personal communication).

3.3 The effect of syntactic boundary.

A tonal signalling of a major syntactic boundary, NP-VP, can be seen in figures 2 and 3, where the fall-rise in connection with the NP-VP boundary is more prominent than the following fall-rise, verb-object boundary (except for KL's statement). In the former case it reaches the baseline, in the latter case it does not. In connection with the NP-VP boundary the tonal configurations in statements and in questions behave differently. In questions the rise is more prominent than the preceding fall. In statements the fall is more prominent than the following rise.

4. CONCLUSIONS

The material presented here is rather limited, but if the results hold for more extensive material it will have importance for the understanding of the function of the topline and the baseline in intonation. It will also have implications for text-to-speech systems and the generating of natural-sounding male and female voices.

REFERENCE

Gårding, E. 1983. Intonation units and pivots, syntax and semantics. Paper to be presented at the International Congress of Phonetics in Utrecht 1983.

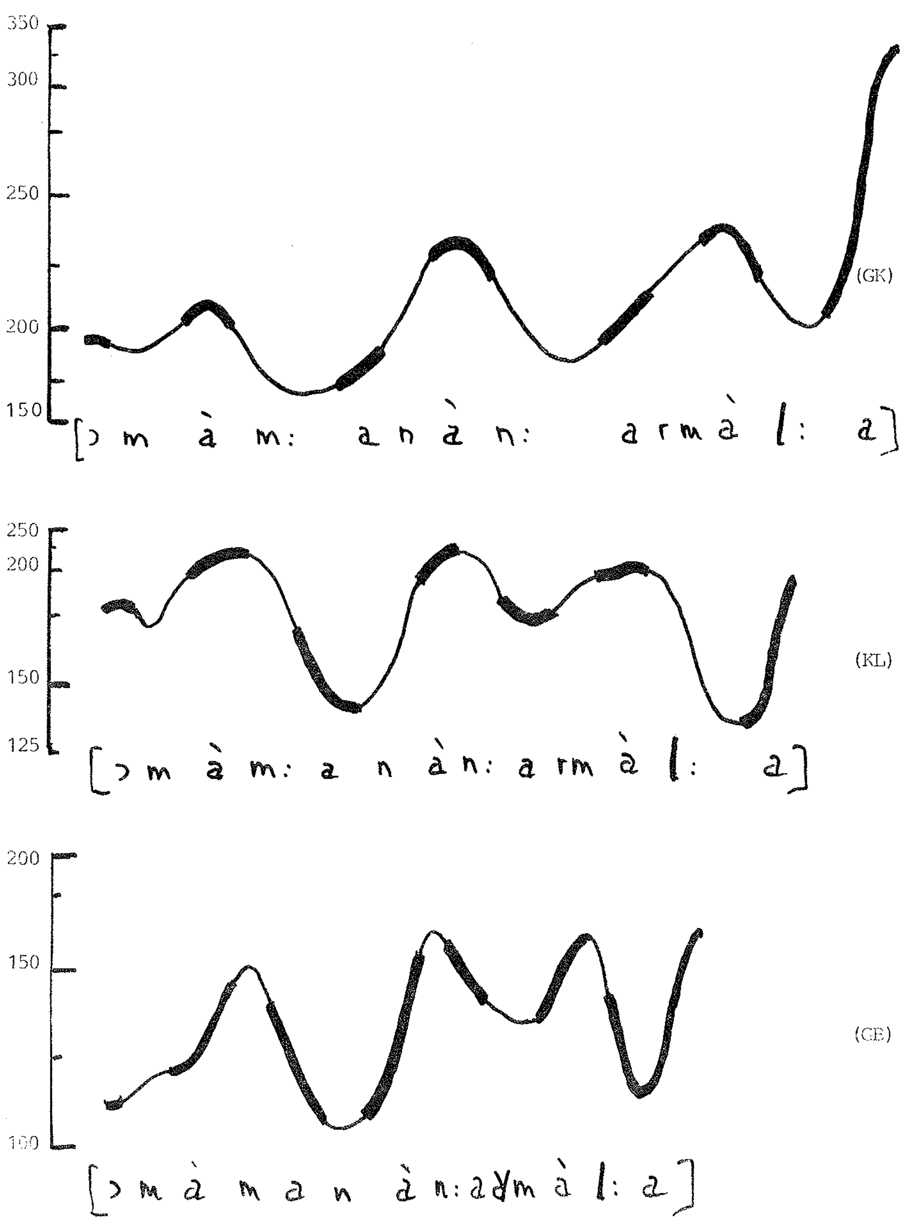

Figure 1. Tracings of typical interrogative tonal curves for two women (GK,KL) and a man (GB).

——— consonant ▬▬▬ vowel

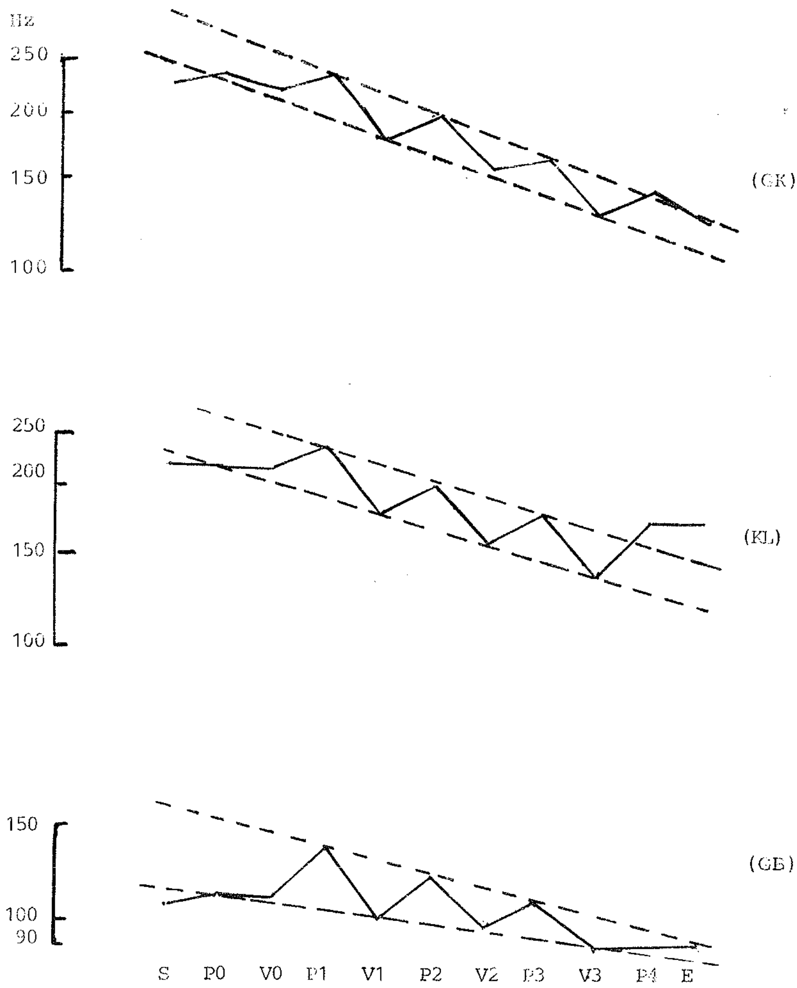

Figure 2. Mean frequency curves for statements. Two women (GK, KL) and a man (GB). S = starting point, P = peak, V = valley, E = endpoint. Logarithmic scale.

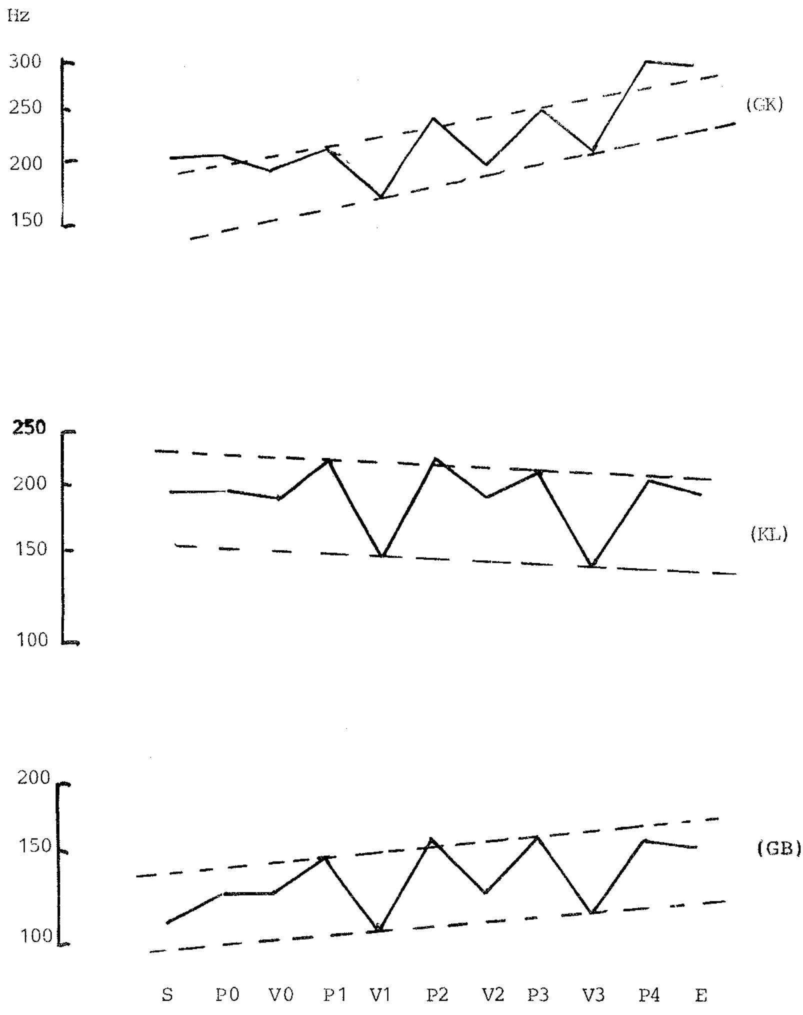

Figure 3. Mean frequency curves for questions. Two women (GK, KL) and a man (GB). S = starting point, P = peak, V = valley, E = endpoint. Logarithmic scale.

Table 1. Frequency values in Hz for the different productions, and mean values. Questions above and statements below. GK, woman. S = starting point, P = peak, V = valley, E = endpoint.

Productions	S	P0	V0	P1	V1	P2	V2	P3	V3	P4	E
1	200	204	190	198	168	212	180	225	180	250	250
2	200	200	180	200	165	222	185	242	210	300	300
3	200	210	195	212	170	230	197	243	205	280	272
4	210	210	198	212	175	233	202	245	215	286	280
5	200	200	190	205	170	240	195	245	193	275	267
6	200	205	195	205	165	242	204	250	210	300	300
7	180	185	183	207	170	240	190	247	203	310	310
8	210	205	200	210	167	238	197	245	210	312	312
9	197	195	190	210	165	233	182	238	198	320	320
10	200	200	185	200	165	238	180	252	205	318	318
Mean values	200	201	191	206	168	233	191	243	203	295	293

Productions	S	P0	V0	P1	V1	P2	V2	P3	V3	P4	E
1	227	235	223	227	177	195	157	163	123	140	130
2	230	235	215	230	190	205	160	168	125	152	130
3	210	227	215	230	183	190	160	158	142	140	125
4	225	230	223	245	190	205	153	154	120	135	115
5	227	240	225	240	190	200	153	162	125	140	120
6	235	240	225	246	190	195	160	163	130	142	120
7	230	240	215	226	177	198	155	160	130	140	130
Mean values	226	235	220	235	185	198	157	161	128	141	124

Table 2. Frequency values in Hz for the different productions, and mean values. Questions above and statements below. KL, woman. S = starting point, P = peak, V = valley, E = endpoint.

Productions	S	P0	V0	P1	V1	P2	V2	P3	V3	P4	E
1	195	195	190	225	150	210	170	196	141	190	187
2	176	180	170	217	142	220	173	201	139	197	195
3	210	212	210	240	154	240	210	222	148	210	195
4	190	190	190	220	140	212	163	192	130	185	166
5	195	195	190	220	146	225	220	228	151	228	215
6	220	220	210	225	157	223	185	210	145	200	198
7	178	178	170	198	140	230	185	209	136	190	180
8	174	175	175	220	147	238	212	220	149	212	210
Mean values	192	193	188	221	147	225	190	210	142	202	193

Productions	S	P0	V0	P1	V1	P2	V2	P3	V3	P4	E
1	245	242	240	260	176	202	148	176	126	185	178
2	215	218	226	245	195	205	158	175	143	191	186
3	235	235	232	242	196	208	175	188	138	184	178
4	240	235	230	240	178	193	158	168	130	156	152
5	175	174	170	210	164	191	154	185	140	172	163
6	178	178	175	203	159	195	150	174	139	177	174
Mean values	215	214	212	233	178	199	157	178	136	172	172

Table 3. Frequency values in Hz for the different productions, and mean values. Questions above and statements below. GB, man. S = starting point, P = peak, V = valley, E = endpoint.

Productions	S	P0	V0	P1	V1	P2	V2	P3	V3	P4	E
1	113	120	124	152	106	163	135	159	115	163	158
2	98	118	120	143	104	156	120	163	118	170	162
3	123	125	120	138	107	155	125	155	110	156	154
4	120	135	135	155	112	162	133	162	117	155	155
5	115	128	130	152	110	162	133	160	122	150	150
6	110	127	133	152	113	160	130	162	127	157	157
7	105	120	120	146	107	165	118	160	125	160	150
Mean values	112	125	126	148	108	160	128	160	119	159	155

Productions	S	P0	V0	P1	V1	P2	V2	P3	V3	P4	E
1	108	114	115	138	105	122	96	110	90	--	90
2	111	111	113	138	105	125	98	111	90	--	90
3	102	110	110	137	104	122	98	110	93	--	93
4	112	111	112	137	102	123	100	110	90	--	90
5	106	115	115	136	100	118	97	111	90	--	90
6	101	107	105	133	102	124	97	102	90	--	90
7	105	107	104	134	104	126	98	103	90	--	90
Mean values	106	111	111	136	103	123	98	108	90	--	90