

Tonal and Temporal Aspects of Child Directed Speech

Ulla Sundberg
Department of Linguistics
Stockholm University
S-10691 Stockholm

ABSTRACT

Disyllabic accent 2 words produced by three mothers to their infants and to an adult were investigated with respect to tonal and temporal characteristics. The F0 fall in the primary stressed first syllable and the F0 rise in the secondary stressed second syllable were measured in terms of pitch change, duration and the speed of the F0 change. The preliminary results support the hypothesis that the F0 rise in the secondary stressed syllable is significantly greater in speech directed to infants than in speech directed to adults. The results also support the hypothesis that the variability is greater in the secondary F0 rise in child directed speech than in the F0 fall in the primary stressed first syllable. A third hypothesis was that pitch and duration are used differentially in marking emphasis in speech directed to infants and adults respectively. The preliminary results suggest individual strategies in this regard.

INTRODUCTION

Child directed speech (CDS) is a speech style typically used by mothers and other care-takers in their interaction with infants. Several investigations have reported on prosodic modifications in phrases, such as higher mean fundamental frequency, wider pitch range, tonally and temporally coherent F0 contours, in child directed speech (CDS) as compared to adult directed speech (ADS), e.g. Fernald & Simon, (1984). The present investigation aims at studying tonal and temporal aspects at the word level, particularly disyllabic accent 2 words produced by three mothers in interaction with their three month old infants.

In a previous pilot study (Sundberg, 1993) two hypotheses about disyllabic accent 2 words in CDS and ADS were tested. The first hypothesis was that the F0 rise in the secondary stressed syllable was significantly different in CDS and ADS. The results showed a significant difference between CDS and ADS. Sentence accent was a highly relevant factor, i.e. whether or not the word(s) seemed to have the greatest prominence in the utterance. In words with sentence accent a clearly significant difference was found in the rise parameter between CDS and ADS, while no significant difference could be found in words without sentence accent. Those results support the hypothesis that the F0 rise in the second syllable was more prominent in CDS than in ADS. The second hypothesis, suggesting that the secondary F0 rise is more variable than the F0 fall in the primary stressed first syllable, was supported by the results that showed less dispersion of the data in the F0 fall than in the F0 rise. Another result in favor of the hypothesis is

that the number of cases with "inverted" F0 changes is much smaller for the fall parameter than for the rise parameter. This means that the expected F0 fall in the first syllable is realized as a F0 rise, and the F0 rise is replaced by a F0 fall.

The tonal difference between words with and without sentence accent was much greater in CDS than in ADS. However, the corresponding difference in duration was much smaller in CDS than in ADS (Sundberg & Lacerda, 1993). Those results may suggest that word emphasis is signalled differentially in CDS and ADS. F0 may be the prime variable of marking prominence in CDS, while in ADS duration may play the corresponding role. The present investigation aimed at testing the above mentioned hypotheses by analysing data from three new mothers.

METHOD

The data collection followed the procedure described in Sundberg, (1993) and will only be mentioned briefly here.

The CDS speech samples were collected from recordings of the three mothers, "Meta", "Lina" and "Tebe", all speaking Central Standard Swedish, while interacting with their three months old infants in a sound isolated booth. The mothers spent half of the time (10 to 15 minutes) playing with the infants and half of the time talking to the investigator in a relaxed and informal way. The ADS speech sample was from this latter session. All disyllabic accent 2 words that were heard as prominent in the utterance were marked with sentence accent.

The following measuring points were chosen; a) the acoustic onset of the first vowel, b) the F0 turning point, c) the acoustic offset of the first vowel, d) the acoustic onset of the second vowel, e) the F0 maximum, f) the acoustic offset of the second vowel. The Fall parameter was defined as the F0 difference between the turning point and the end of the first vowel. The Rise parameter was defined as the difference between the turning point of the second vowel and the offset of the first vowel. Words in sentence final position, questions and compounds were excluded from the investigation. Several words were not possible to analyse because of creaky voice, whisper, noise, for example. From Lina, 83 and 92 words with and without sentence accent respectively, were analyzed, from Meta, 108 and 95 and from Tebe 44 and 62. Approximately half of the words were from the CDS and half from ADS.

RESULTS

The data were analyzed in two steps. First, the measurements were submitted to an analysis of variance, ANOVA, in which Fall and Rise were viewed as repeated measures and subject (the different mothers), direction (CDS and ADS) and sentence accent (with and without) as factors. Preliminary results show a clear significant difference between CDS and ADS. The difference in the two speech styles is also very significant when interaction with the factor sentence accent is included in computation. When the F0 fall (calculated in semitones related to 100 Hz) is separated from the F0 rise, the results show virtually no difference in the Fall parameter, ($F(1, 472) P > 0.1$), while the Rise parameter differs significantly in CDS as compared to ADS ($F(1, 472) p < 0.001$). A

comparison of the average magnitude of Fall and Rise parameters within CDS and ADS indicate that the latter being significantly much larger than the former.

In the second step of the analysis the rate of the pitch change associated with the differences in the F0 excursions in CDS and in ADS were calculated. The analysis was made on a subset of the words in the above mentioned analysis. Words that met with the following criteria were included; (1) The highest pitch of the first vowel occurred at its onset, (2) the highest pitch of the second vowel did not occur at its onset, but later. The duration of the F0 fall in the primary stressed syllable thus encompassed the first vowel segment, and the F0 rise in the secondary stressed syllable included the medial consonant(s) up to the point of the F0 maximum of the second vowel. The results to suggest that the main factor is the presence of sentence accent. The data from one of the mothers, though, Tebe, seem to support the hypothesis about F0 being the prime variable in marking emphasis in CDS and duration being the corresponding one in ADS. (See Figure 1a and b). Her mean duration in the Rise parameter is clearly larger in ADS than in CDS (for words with sentence accent). The data from Lina, on the other hand, show almost the same mean duration in ADS as in CDS, and Meta, has an increase in mean duration both in the Fall and Rise parameters.

The great variability in spontaneous speech is reflected in the present data by a number of "inverted" F0 contours. This phenomenon occurs in 10% to over 20% in both speech styles in words with sentence accent. In words without sentence accent the corresponding numbers increase substantially, as expected.

DISCUSSION

The results support the above mentioned first hypothesis, namely, that the secondary F0 rise is significantly different in CDS as compared to ADS. This result holds for words with sentence accent, but not for words without sentence accent. The variability in the Fall parameter is much less, both in pitch and in duration than the Rise parameter, for the three mothers. This corroborates conclusions by Engstrand, (1989) and Bruce (1977) who found the F0 fall in the primary stressed first syllable to be the robust characteristic of accent 2. The second hypothesis suggested that the secondary F0 rise is more variable than the primary F0 fall in CDS. All three mothers confirm this, both when data from CDS and ADS are pooled and when they are treated separately. These results are in agreement with earlier results showing that the Rise parameter is more sensitive to degree of emphasis than is the Fall parameter.

The third hypothesis concerned the possibility of differential use of pitch and duration as markers of prominence in CDS and ADS. The data reveal different strategies between the mothers. All three mothers clearly use F0 as marker of emphasis in CDS while their use of duration, and its interaction with F0 need further statistical exploration.

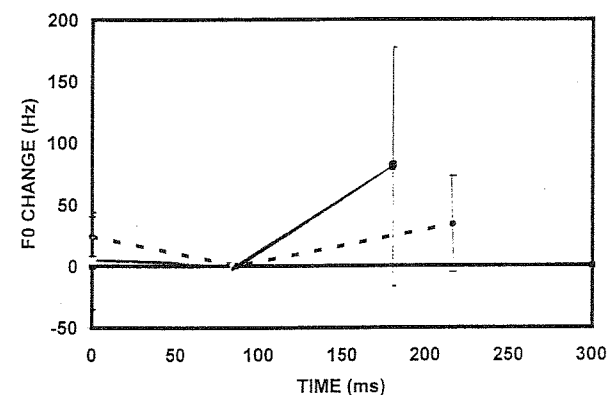
ACKNOWLEDGEMENT

I am most grateful to Francisco Lacerda for his assistance with the statistical computations.

REFERENCES

- Bruce, G. 1977. 'Swedish word accents in sentence perspective'. *Travaux de l'Institut de Linguistique de Lund*, 12, Gleerup.
- Engstrand, O. 1989. 'Phonetic features of the acute and grave word accents: data from spontaneous speech'. *PERILUS X*, 13-37.
- Fernald A., Kuhl, P. 1987. 'Acoustic determinants of preference for motherese speech'. *Infant Behaviour and Development* 10, 279-293.
- Sundberg, U. 1993 'Word accent 2 in child directed speech: A pilot study'. *PERILUS XVII*, 65-74.
- Sundberg, U., Lacerda, F. 1993. 'Swedish tonal word accent 2 in child directed speech - a pilot study of tonal and temporal characteristics'. *PERILUS XVII*, 75-79.

"TEBE" WITH SENTENCE ACCENT



"TEBE" WITHOUT SENTENCE ACCENT

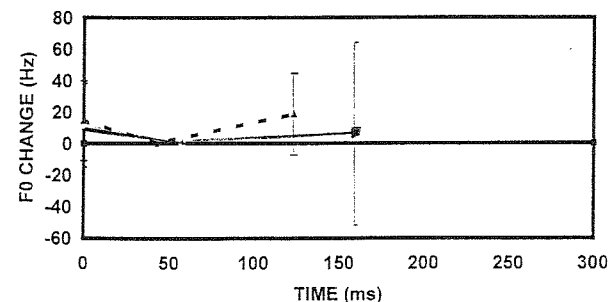


Figure 1a and b. Mean F0 change as a function of time in words with and without sentence accent for mother Tebe. CDS is marked with solid lines and ADS is marked with dotted lines. The bars represent +/- one standard deviation. The first section pertains to the F0 fall in the first syllable, and the second one relates to the F0 rise in the second syllable.