The prosodic characteristics of "motherese" were examined in the speech of 24 German mothers to their newborns. Each subject was recorded in three observational conditions, while addressing (a) her 3- to 5-day-old baby (M-B Speech); (b) the absent infant, as if present (Simulated M-B Speech); and (c) the adult interviewer (M-A Speech). For each subject, 2-minute speech samples from each condition were acoustically analyzed. It was found that in M-B Speech, mothers spoke with higher pitch, wider pitch excursions, longer pauses, shorter utterances, and more prosodic repetition than in M-A Speech. Furthermore, 77% of the utterances in the M-B Speech sample conformed to a limited set of prosodic patterns that occurred only rarely in adult-directed speech, i.e., they consisted of characteristic "expanded" intonation contours, or they were whispered. The prosody of mothers' speech is discussed in terms of its immediate influence within the context of mother-infant interaction, as well as its potential long-range contribution to perceptual, social, and linguistic development.

The language spoken by adults to young children is simpler than the language spoken among adults, as we know from numerous studies showing that in "motherese," adults modify their speech syntactically, semantically, and phonologically (see Snow, 1977a, for a review). The prosodic organization of "motherese" is less well understood, although the use of higher pitch, slower tempo, and exaggerated intonation in adult speech to children has been reported in several languages (e.g., Blount & Padgug, 1976; Ferguson, 1964). However, these characteristic prosodic modifications in "motherese" have until recently received little systematic acoustic analysis (Fernald & Simon, 1977; Garnica, 1977; Stern, Spieker, Barnett, & MacKain, 1983; Stern, Spieker, & Mackain, 1982). In this study we examine the nature and extent of prosodic modifications in the speech of German-speaking mothers to their newborns.

Although a few recent studies have examined linguistic aspects of speech to young infants (Kaye, 1980; Snow, 1977b; Rheingold & Adams, 1980), most maternal-speech research has focused on speech to children in the 1-to-5-year range (e.g., Bellinger, 1980; Cross, 1977; Messer, 1980; Snow, 1972). This emphasis reflects the view that a primary function served by the simplification of adult speech to children is the facilitation of language learning. Thus "motherese" is studied as a source of linguistic information for the child at the time of most rapid language development, and patterns of change in mothers' speech are seen as adjustments of language input finely tuned to the child's increasing linguistic competence. The fact that many syntactic and semantic features of mother's speech remain relatively constant over the first 18 months (Snow, 1977b), when most children are only beginning to produce and to respond overtly to language, is consistent with this interpretation.

However, the view of mothers' speech as relatively unchanging during the first year rests
entirely on syntactic evidence. When the prosodic and pragmatic aspects of mothers' speech are considered, a different picture emerges. From a pragmatic perspective, Snow (1977b) documents consistent changes in mothers' language behavior over the first year, as the child's ability to function actively as a conversational partner improves. The prosodic features of mother's speech have also been shown to change consistently in the prelinguistic period. In a longitudinal study of mothers' speech to their infants from birth to 6 months, Stern et al. (1983) found age-related changes in prosodic features but not in syntactic/semantic features. Thus in its prosodic as well as pragmatic organization, although not in syntactic structure, "motherese" has been shown to be dynamically responsive to changes in infant behavior in the first year of life.

Although infant responsiveness to the linguistic structure of mothers' speech may well not develop until later in the first year, it seems likely that the melody of speech—its intonation, tempo, and rhythm—has immediate impact on even very young infants. The social smiles of young infants are at first more effectively elicited by a high-pitch human voice than by visual or other auditory stimuli (Wolff, 1963). Furthermore, Fernald (1982) found that 4-month-old infants chose more often to listen to the pitch contours of "motherese" than to those of normal adult conversation in an auditory preference study. These findings suggest that "motherese" pitch contours are perceptually highly salient in the infant and may be particularly well matched to the young infant's perceptual and attentional capabilities (Fernald, 1983).

In the present study, the prosodic patterns of German mothers' speech to newborns are characterized, and the following questions are addressed. How extensive are the prosodic modifications in mothers' speech to newborns? Do experienced and inexperienced mothers modify their speech in the same way? Is the presence of the infant necessary to elicit "motherese," and do the prosodic features of mothers' speech vary with infant state? Finally, to what extent do repetitions of intonation contour in mothers' speech to newborns coincide with linguistic repetitions?

Method

Subjects

The subjects were 24 German-speaking mothers of healthy, full-term newborns (3–5 days old), with no perinatal complications. Twelve of the women were primiparous, with little previous experience with infants. The other subjects each had one other child. While residing as maternity patients, the subjects were invited by the pediatric staff to participate in the study. All subjects expressed willingness to volunteer for the study out of interest and because their participation allowed them an extra "social hour" with their infants beyond the scheduled nursing times.

Procedure

On the second day following delivery, each subject was visited by the experimenter (A.F.), who explained that this research concerned infant social behavior. Subjects were not told until after the recording session that the mother's vocalizations were of primary interest. Within the next 3 days, a recording session was held with each subject, seated comfortably in bed or in an armchair in a single-occupancy room. Subjects were audiorecorded (Uber 4200 Report, Sony Lavalier microphone) in three observational situations:

1. M-A Speech  Adult-directed speech was recorded in conversation between mother and experimenter. Although the topics of discussion varied among subjects, all were quite spontaneous and animated.

2. M-B Speech  Infant-directed speech was recorded while the mother held her baby in her arms. The infant was brought into the room approximately 1 hour before the midmorning or afternoon feeding time. Of the 24 infants, 11 were asleep or drowsy, 6 were awake and quiet, and 7 were awake and restless at the beginning of the recording session.

3. Simulated M-B Speech  Each subject was asked to make a 2-minute recording for her infant while the baby was out of the room, supposedly to be played to the child at a later time.

The order of the three recordings was counterbalanced across subjects. The experimenter was in the room throughout the recording session, although out of the mother's sight during the two infant-directed recordings. The infant was in the room only during the recording of M-B Speech.

Data Reduction

Two-minute speech samples from each subject in each of the three observational conditions were excerpted for intensive acoustic analysis, according to the following selection criteria:

1. From each M-A Speech recording, the first uninterrupted 2-minute sample was selected where background noise was low and where the experimenter's contribution to the conversation was limited to the occasional monosyllable. For seven subjects, it was necessary to combine two shorter sections of speech to make up the 2-minute sample for acoustic analysis.
2. From each M-B Speech recording, the first 5-minute section was eliminated for purposes of analysis. The next uninterrupted 2-minute speech sample was selected where background noise was low and the baby was relatively quiet. The rationale for this selection was that the mother was more thoroughly involved with the infant after the first few minutes and had had an opportunity to try to awaken the baby, if the baby was asleep on arrival in the room.

3. The Simulated M-B Speech recordings were used in their entirety.

The data were processed on a PDP 11/45 computer using a pitch-extraction program developed for this study by Simon (Fernald & Simon, 1977), which enables accurate measurement in continuous speech samples of three prosodic parameters: fundamental frequency (F₀), amplitude, and duration. The text for each 2-minute speech sample was transcribed by an observer trained in phonetics, who listened repeatedly to the tape recordings while watching a simultaneous oscilloscopic display of the speech signal. Comparison of this display with the amplitude envelope on the computer printout enabled accurate segmentation of each utterance.

**Dependent Measures**

**Mean utterance duration and mean pause duration.** An "utterance" was defined acoustically rather than linguistically, as a section of speech bounded by pauses greater than 300 ms. (cf. Jaffe & Feldstein, 1970). The durations of utterances and pauses were measured from the amplitude envelope plots.

- **Mean F₀:** The mean F₀ for each 2-minute speech sample was calculated by the computer (sampling rate = 10 kHz).
- **Mean F₀-excursion:** The distance in semitones between the F₀-minimum and F₀-maximum for each utterance was measured from the logarithmic plot of F₀ over time, then divided by the utterance duration to yield a measure of F₀-excursion in semitones-per-second (12 semitones = 1 octave). Whispered and partially whispered utterances were excluded from this calculation.

**Duration of articulation.** For each speech sample, the total number of syllables was divided by the total speech time, exclusive of pauses.

**Correspondence of pauses with sentence boundaries.** A native German-speaking linguistics student marked sentence boundaries on transcripts of the 72 speech samples. These transcripts were then compared with the F₀-and-amplitude plots, on which the acoustically defined utterance and phrase boundaries were indicated and were scored for the percentage of pauses that coincided with sentence boundaries.

**Contour types.** In order to characterize recurring intonational patterns, the pitch contours in mothers' speech to newborns were classified into 13 "expanded" intonation contour types (see Figure 2), which were suggested by visual inspection of the data. Each contour type was defined in terms of pitch range and slope and the number of major shifts in pitch direction within the contour. A minimum F₀-excursion of 6 semitones/s was a defining characteristic of all but three of the contour-types in Figure 2. However, these three contour types, a₁, b₁, and c₁, were exaggerated in other prosodic dimensions. Contour types a₂ and b₄, which accompanied question tags such as "Hmmm?" or "Gel," were spoken at a high pitch level well above that typical of tag-endings in adult–adult speech. Contour type c₁, although low in pitch, was exaggerated in duration, generally accompanying an elongated monosyllable such as "Jaaaaa." Thus, although not expanded in pitch range, these three contour types were included in this typology on the basis of other exaggerated prosodic features that distinguished them from typical adult–adult intonation contours.

Using this typology, two trained coders independently categorized each utterance in the three observational conditions. M-A Speech (n = 995), M-B Speech (n = 1156), and Simulated M-B Speech (n = 1010). The coders' task was to judge whether an utterance was an exemplar of one of the 13 expanded-intonation contour types or whether it was whispered. All utterances not included in these categories were classified as falling within the range of normal adult–adult intonation. Intercoder agreement was 86%.

**Repetitions.** The following two types of repetition were measured.

1. **Phrase Repetition.** Phrases repeated verbatim or with minor modification, within the next two utterances, were scored as phrase repetitions. Permissible modifications included contractions, and, in utterances longer than three words, the addition, deletion, or substitution of a single morpheme or word, as in "Schau her zu mir . . . Schau mal her zu mir." However, successive utterances with substitutions resulting in a substantial change in meaning, as in "Hast du kein Hunger? Hast du doch Hunger," were not scored as phrase repetitions.

2. **Prosodic Repetition.** Either a specific contour type followed within the next two utterances by the same contour type, or a whispered utterance followed within the next two utterances by another whispered utterance, was scored as prosodic repetition.

**Results.**

Comparison of the speech samples of one subject in the three observational conditions (see Figure 1) illustrates several differences between the prosodic patterns of adult-directed and infant-directed speech. Six measures of tonal and temporal organization are summarized for all subjects in Table 1. In M-B Speech, mean F₀ was higher, pitch excursions were greater, utterances were shorter, pauses were longer, and articulation rate was slower than in M-A Speech. Furthermore, in M-B Speech pauses almost invariably coincided with sentence boundaries, whereas in M-A Speech they seemed to be more arbitrarily distributed in relation to grammatical structure. For all these measures, highly significant differences were found between M-B Speech and M-A Speech, using the Wilcoxon matched-
EXPANDED INTONATION IN MOTHERS’ SPEECH

107

pairs signed-rank test (Siegel, 1956) and the percentage equality test (Sokal & Rohlf, 1969).

Although these prosodic modifications in infant-directed speech were most extreme when the infant was present, they were evident to some extent in Simulated M-B Speech. Although mean $F_0$ did not rise significantly in this condition, pitch excursions, utterance and pause durations, articulation rate, and correspondence of pauses with sentence boundaries in Simulated M-B Speech were all significantly different from M-A Speech, using the statistical tests described above. For most of these measures, the values in Simulated M-B Speech were intermediate between those in the other two conditions.

Further statistical analyses were undertaken to test the effects of maternal parity and infant state on prosodic modifications in M-B Speech. Both sexes were combined for this purpose, since preliminary analysis had revealed no differences in M-B Speech to male and female infants for any of the dependent measures. A Maternal Parity (primaparous, multiparous) $\times$ Infant State (drowsy, awake-alert, awake-restless) analysis of variance (ANOVA), with unequal groups (Keppel, 1973) was performed for each dependent variable. No significant main effects or interactions were found, although an effect of infant state on certain parameters of M-B Speech was suggested by the data. As can be seen in Table 2, M-B Speech addressed to restless infants was characterized by longer utterances, shorter

![Graph A](image)

![Graph B](image)

![Graph C](image)

*Figure 1* Pitch contours from one subject in three conditions (a) speech to adult (M-A Speech); (b) speech addressed to absent infant (Simulated M-B Speech), (c) speech to infant, held in mother’s arms (M-B Speech). Ordinate shows fundamental frequency (F) in hertz, plotted logarithmically.
pauses, and slower articulation rate compared to speech addressed to infants that were either drowsy or alert and quiet. Mothers attempting to soothe restless infants typically used elongated monosyllables, such as “Jaaaa” or “Ooooh,” often with falling pitch contours spaced closely in repetitive runs, a speech pattern reflected in the above measures.

**Contour Types**

Closer analysis of the intonation contours of the M-B Speech revealed the most remarkable finding of this study: 77% of the utterances addressed to newborns conformed to prosodic patterns occurring only rarely in adult-directed speech. These prosodic patterns consisted either of “expanded” pitch contours or whispered speech. The expanded pitch contours were generally characterized by long, smooth, continuous pitch glides, with F₀-excursions averaging 13 semitones/s, sometimes exceeding two octaves in range.

As shown in Figure 2, the majority of these expanded contours consisted of essentially uni-directional pitch glides, either rising (a) or falling (b). Contour-types a₁ and b₁ typically accompanied monosyllables, whereas contour types a₂, b₂, and b₃ had 2 to 5 syllables. Utterances with “bell shaped” contours (d), with a single major shift in direction of pitch movement, contained an average of seven syllables. The “level” contours (c) were characterized by prolonged steady-state vowels, either a monosyllable spoken on a single-level tone (c₁) or two syllables spoken on different pitch levels, with either a rising (c₂) or falling (c₃) interval. “Complex” expanded contours (e), involving two major shifts in direction of pitch movement, occurred much less frequently in infant-directed speech than the more simple pitch patterns.

The distribution of normal intonation contours, expanded intonation contours, and whispered speech in each observational condition, across subjects, is shown in Figure 3. Expanded contours comprised 59% of the utterances addressed to the infant in M-B Speech and 32% of the utterances in Simulated M-B Speech. In adult-directed speech they occurred

### Table 1
**Comparison of Selected Tonal and Temporal Parameters of Mothers’ Speech in Three Conditions**

<table>
<thead>
<tr>
<th>Parameter (M)</th>
<th>Mother-adult (M-A) speech</th>
<th>Simulated M-B speech</th>
<th>Mother-baby (M-B) speech</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fundamental frequency (Hz)</strong></td>
<td>203</td>
<td>201</td>
<td>257**</td>
</tr>
<tr>
<td><strong>Pitch excursion/s (semitones)</strong></td>
<td>3.5</td>
<td>6**</td>
<td>11**</td>
</tr>
<tr>
<td><strong>Utterance length (s)</strong></td>
<td>2.2</td>
<td>1.5**</td>
<td>1.1**</td>
</tr>
<tr>
<td><strong>Pause length (s)</strong></td>
<td>0.8</td>
<td>1.5**</td>
<td>1.5**</td>
</tr>
<tr>
<td><strong>Articulation rate (syllables/s)</strong></td>
<td>5.8</td>
<td>5.0**</td>
<td>4.2**</td>
</tr>
<tr>
<td><strong>Correspondence of pauses with sentence boundaries (%)</strong></td>
<td>68</td>
<td>92*</td>
<td>98*</td>
</tr>
</tbody>
</table>

* p < .05, percentage equality test  ** p < .001, Wilcoxon matched-pairs signed rank test.

### Table 2
**Comparison of Selected Tonal and Temporal Parameters of Mothers’ Speech in the Mother-Baby Speech Condition as a Function of Infant State**

<table>
<thead>
<tr>
<th>Parameter (M)</th>
<th>Asleep/drowsy (n = 11)</th>
<th>Awake-quiet (n = 7)</th>
<th>Awake-restless (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fundamental frequency (Hz)</strong></td>
<td>270</td>
<td>245</td>
<td>247</td>
</tr>
<tr>
<td><strong>Pitch excursion/s (semitones)</strong></td>
<td>11.1</td>
<td>11.7</td>
<td>10.2</td>
</tr>
<tr>
<td><strong>Utterance length (s)</strong></td>
<td>.90</td>
<td>1.0</td>
<td>1.4</td>
</tr>
<tr>
<td><strong>Pause length (s)</strong></td>
<td>1.5</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Articulation rate (syllables/s)</strong></td>
<td>4.3</td>
<td>4.3</td>
<td>3.8</td>
</tr>
</tbody>
</table>
only 6% of the time, typically when the subject was speaking with great animation or when she was imitating speech addressed to, or spoken by, a young child. Whispered speech, which comprised 18% of the M-B Speech utterances and 6% of the Simulated M-B Speech utterances, did not occur at all in M-A Speech.

This predominance of expanded intonation contours and whispering in M-B Speech shows that the prosodic organization of speech to infants is dramatically different from that of normal adult-adult conversation. The sounds of maternal speech to infants are organized, to a large extent, into long, smooth, continuous pitch contours, greatly expanded in F₀-range, and separated from one another by extended pauses. The intonation contours of adult-directed speech, by comparison, are considerably more complex and variable, characterized by relatively narrow F₀-range and by multiple shifts in the direction of pitch movement within a single utterance.

Table 3 shows that prosodic repetition (that is, the occurrence of a particular expanded intonation contour type followed within two utterances by the same contour type, or the occurrence of a whispered utterance followed within two utterances by another whispered utterance) was extensive in M-B Speech. Prosodic repetitions sometimes co-occurred with phrase repetitions (4.4%), i.e., the same phrase was repeated with the same prosodic contour. However, it was more often the case that prosodic repetition occurred without concomitant phrase repetition (11.8%), i.e., the same prosodic contour was repeated with varying linguistic content.

Table 3

<table>
<thead>
<tr>
<th>Repetition</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phrase without prosodic</td>
<td>4.4</td>
</tr>
<tr>
<td>Phrase/phrase</td>
<td></td>
</tr>
<tr>
<td>Prosodic without phrase</td>
<td>6.7</td>
</tr>
<tr>
<td>Contour/contour</td>
<td></td>
</tr>
<tr>
<td>Whisper/whisper</td>
<td>5.1</td>
</tr>
<tr>
<td>Phrase with prosodic</td>
<td>3.7</td>
</tr>
<tr>
<td>Phrase + contour/phrase + contour</td>
<td></td>
</tr>
<tr>
<td>Phrase + whisper/phrase + whisper</td>
<td>0.7</td>
</tr>
<tr>
<td>Total phrase</td>
<td>8.8</td>
</tr>
<tr>
<td>Total whisper</td>
<td></td>
</tr>
<tr>
<td>Total prosodic</td>
<td>16.2</td>
</tr>
</tbody>
</table>

Figure 2 Expanded intonation contour-types characteristic of mothers' speech to newborns: (a) unidirectionally rising (37%); (b) unidirectionally falling (24%); (c) level tones (6%); (d) bell-shaped or U-shaped contours (23%); (e) complex (10%). Percentages represent distribution of 682 utterances classified as expanded intonation contours in mothers' speech to newborns.
Discussion

It was found in this study that mothers radically modified the normal tonal and temporal patterns of their speech when addressing their newborns. The intonation contours of normal adult–adult speech were altered in the presence of the infant to an extent that was quite unexpected: 77% of the mothers’ infant-directed utterances conformed to a limited set of prosodic patterns that were found only rarely in adult-directed speech, i.e., they consisted of expanded intonation contours or they were whispered. These prosodic modifications were similar in the infant-directed speech of both primiparous and multiparous mothers, suggesting that extensive previous experience with infants is not a prerequisite for the occurrence of this maternal behavior.

Even without the infant present, in Simulated M-B Speech, mothers modified their prosody in the direction of M-B Speech. This finding is consistent with Snow's (1972) conclusion, in her study of speech to older children, that mothers speaking to an absent child are to some extent able to predict appropriate syntactic and semantic modifications. However, the full range of prosodic modifications in mothers’ speech was evoked only in the presence of the infant, suggesting that feedback from the baby is important in eliciting and shaping “motherese.”

It seems surprising that infant-directed speech was not found to vary significantly with infant state, if feedback from the infant is indeed influential in shaping “motherese.” However, it should be noted that the prosodic differences in mothers’ speech to infants varying in arousal level are probably quite conservatively estimated here, for two reasons particular to this study. First, speech addressed to babies who had begun to cry, even intermittently, was not included in the sample, since instrumental acoustic analysis of such speech samples was complicated by the presence of infant vocalizations. Thus, the “restless” babies in this study were, in fact, only mildly distressed. Second, since the mothers speaking to “asleep or drowsy” infants were all attempting to waken their babies by getting their attention, their speech was hardly representative of speech to drowsy infants under all circumstances. Obviously, mothers are often intent on calming rather than arousing a sleepy infant, in which case infant-directed speech would undoubtedly show very different prosodic characteristics. Thus, although the data suggest that the prosody of speech to newborns is responsive to infant state, such modifications were not strongly evident here, probably because the full range of newborn arousal states was not adequately represented.

An interesting finding in this study was that the overall incidence of prosodic repetition in infant-directed speech was 16.2%, whereas the incidence of linguistic repetition was only 8.8%. (These figures include a 4.4% “overlap,” where both phrase and prosodic contour were repeated.) Several previous studies have suggested that repetitiveness is an important feature of mothers’ speech, although opinions have varied as to why this should be the case. Snow (1972) suggests that frequent repetition in speech to older infants may facilitate language learning. Kaye (1980) finds this explanation implausible, since the 2-year-olds in his study did not respond verbally, regardless of how often the mother repeated herself. Furthermore, a language-teaching explanation cannot account for the high incidence of phrase repetition in speech to young infants not yet responsive to linguistic content. Stern et al. (1983), in their study of infant-directed speech in the first 6 months, found that phrase repetition peaked at 2 months, reaching a level of 50%. These authors suggest that the high degree of phrase repetition enhances the predictability of maternal behavior. Whatever level of explanation is preferred, it would appear that “motherese” is considerably richer in repetition than these previous studies have indicated, since they took only linguistic repetition into account. In the present study, the overall frequency of prosodic repetition was nearly twice that of phrase repetition. Prosodic repetition would seem to be a potentially important level of redundancy in maternal speech, since it may be more immediately accessible to young infants than is the repetition of segmentally complex linguistic messages.

When considering the effects on the infant of repetition in any dimension, an obvious caveat is in order. The occurrence of “repetition” can be assessed by an adult observer using criteria that define an utterance, in terms of verbal structure and content, in terms of
prosodic structure, or both. However, this classification of two successive vocalizations as a “repetition” should imply nothing about their perceptual equivalence for the infant. We have no evidence that newborns perceive two linguistically identical utterances as repetitions of the same stimulus event. Although it seems more likely that infants might perceive two identical intonation contours as similar, again there is no evidence. Thus the taxonomy of expanded pitch contours characteristic of mothers’ speech proposed in this study should be seen as a heuristic, suggesting levels of acoustic redundancy that are potentially available to the infant.

In what ways might the exaggerated prosodic patterns of “motherese” be especially effective for communicating with the young infant? Four hypotheses about the contribution of mothers’ speech to infant development will be considered. The prosodic characteristics of mothers’ speech will be discussed both in terms of possible “proximate” effects, i.e., their immediate influence within the ongoing mother-infant interaction, as well as possible “ultimate” effects, i.e., their contribution to long-range developmental goals such as language acquisition (see Fernald, 1983).

1. The first hypothesis is that maternal vocalizations serve initially to gain and maintain the infant’s attention and to modulate arousal level. The finding that infants prefer to listen to “motherese” pitch contours (Fernald, 1982) suggests that the intonation patterns of mothers’ speech may be perceptually particularly salient to the infant and thus more interesting as auditory stimuli. If change, contrast, and movement are the critical factors determining infant attentiveness to both visual and auditory stimuli, as Kagan (1970) has claimed, then the exaggerated pitch modulations of “motherese” could be optimal auditory signals for engaging and holding infant attention.

The temporally well-defined and acoustically prominent patterns of mothers’ speech may serve to enhance communication in early social encounters, given the limited attention span and cognitive capacities of the infant (Papousek & Papousek, 1975, 1981). This view is supported by the finding that mothers use specific intonational patterns in particular behavioral contexts, with the goal of engaging and maintaining infant attention and modulating arousal level (Stern et al., 1982). Similarly, Snow (1977b) argues that mothers mark the boundaries of their conversational “turns” by using prominent intonation patterns, as if to signal the infant, “Now it’s your turn to respond.”

2. A second hypothesis is that the prosodic features of mothers’ speech may be particularly effective in communicating maternal affect to the infant. Several studies (e.g., Scherer, 1979) have shown that high pitch and expanded pitch range in normal adult-adult conversation are acoustic concomitants of positive affect, signalling pleasantness and happiness, as well as vitality and surprise, to adult listeners. In mothers’ speech to infants, several such prosodic attributes known to convey emotional information are exaggerated well beyond the range of normal adult speech, perhaps providing prominent affective cues for the infant.

3. A third hypothesis is that the expanded intonation contours of “motherese” may aid the infant in identifying the mother. Adults, listening to filtered speech with all segmental information removed, are able to identify familiar speakers solely on the basis of pitch contour shape and mean fundamental frequency (Abberton & Fourcin, 1978), which suggests that prosodic patterns provide considerable information about individual speakers. Mehler, Bertoncini, Barrière, and Jassik-Gerschenfeld (1978) found that 1-month-old infants recognized the voice of their own mother when speaking highly intonated speech but not when speaking in a monotone, indicating that maternal intonation may be a critical factor in infant voice recognition.

4. A fourth hypothesis is that the prosodic patterns of mothers’ speech may play a role in the development of speech perception skills. Ultimately, the child learns to impose a linguistic organization on the sounds he or she hears, using phonological, syntactic, and semantic knowledge to interpret any given sound element within the continuous stream of speech. For the linguistically inexperienced infant, however, intonation and rhythm could be of primary importance in conveying information about language.

There are several ways in which the prosodic features of maternal speech might contribute to the development of basic speech-processing skills. Studies of adult intonation, for example,
suggest that prosodic contours allow the listener to attend selectively to one voice among many more readily (Nooteboom, Brokx, & deRooij, 1976). The impressive degree of pitch continuity in “motherese” intonation contours may be critical in tying the successive speech sounds of an utterance into a single, acoustically coherent stream. Bregman and Dannenbring (1973) have shown that when high and low tones are rapidly alternated, the sequence of sounds will split into two perceptually separate groups, a phenomenon known as “auditory stream segregation.” Stream segregation is greatly reduced, however, when transitions between successive tones are gradual and continuous, rather than abrupt. In mothers’ speech to newborns, the intonation contours are typically long, smooth, glissandi, where abrupt pitch transitions rarely occur. Thus, although expanded pitch range allows for greater acoustic contrast among individual elements within the utterance, the perceptual integrity of the utterance may be enhanced by the use of smooth, continuous pitch excursions.

Another feature of the acoustic organization of “motherese” that might play a role in the development of speech-processing skills is the exaggerated temporal rhythmicity that sometimes occurs, where intervals between accented syllables become almost metrically regular over a span of several utterances. Martin (1972) has suggested that such rhythmic patterns optimize analysis of the more informative elements of the speech signal. Similarly, Nooteboom and Cohen (1975) argue that rhythmically structured pitch contours are temporally coherent auditory configurations that may facilitate speech processing by enabling the listener to allocate attention efficiently. The prosodic rhythmicity of mothers’ speech is further enhanced by the frequent repetition of similar pitch contours. Thus, in various dimensions, infant-directed speech is acoustically more redundant than adult-directed speech. This temporal and tonal redundancy may aid the infant in auditory pattern recognition, an essential skill in the development of speech perception.

The prosodic organization of mothers’ speech may also provide acoustic cues to the syntactic and semantic structure of messages. Studies of adult speech perception suggest that intonation grouping sets up initial speech-processing units, and that comprehension is adversely affected when prosodic and syntactic boundaries conflict (Darwin, 1975; Glanzer, 1976; Wingfield, 1975). In “motherese,” prosodic and syntactic boundaries almost invariably coincide. Although the infant is obviously incapable of appreciating such relationships at first, perhaps the persistent acoustic emphasis of phrase boundaries in “motherese” contributes to the development of the infant’s ability to discern syntactic structures within the stream of speech. Similarly, the mother’s consistent use of pitch peaks to highlight new information may help the child to acquire word meanings (Fernald & Mazzie, 1983).

In conclusion, the melody and rhythm of mothers’ speech to newborns, so dramatically different from adult-directed speech, may be appropriate in many ways for successful communication with the infant. Exaggerated, rhythmic vocalizations are among a number of characteristic maternal behaviors that may function to regulate the infant’s attention and social responsiveness. Expanded intonation contours may also enhance the infant’s recognition of individual voices and of the emotional content of messages. Also, vocal behavior is simultaneously verbal behavior in human mothers most of the time, and maternal speech may well contribute to the development of specifically linguistic skills. Perhaps, as DuPreez (1974) has suggested, maternal intonation teaches the child the first tunes of his or her language, tunes that may then function as schemes that the infant can use in sampling the acoustic environment. After all, the infant is learning language from the beginning, in the sense that perceptual skills essential for speech processing are being exercised and integrated. The exaggerated prosody of “motherese” may contribute to the development of such skills as pitch and temporal order discrimination, and auditory pattern recognition—skills that are “prelinguistic” in the most fundamental sense. Although the contributions of early auditory and linguistic experience to infant development are still largely unexplored, it seems possible that mothers’ speech to infants may function in all of the above ways, contributing to social, linguistic, and perceptual development.
References


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