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AUTHOR Papousek, Mechthild
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INSTITUTION Max-Planck-Inst. for Psychological Research, Munich (West Germany).; National Inst. of Child Health and Human Development (NIH), Bethesda, Md.
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ABSTRACT

In a comparison of the melodies in the speech of Mandarin Chinese and Caucasian American mothers, striking similarities were found: (1) in the overall distribution and average structure of melodic contours; (2) in close contextual links to given forms of intuitive parental care; and (3) in a tendency to neglect lexical tones in favor of pitch modulation. These findings strongly support the notion of a cross-cultural universality of maternal melodies, and indicate a primary biological determination. At the same time, significant differences were found with regard to the extent of speech adjustments. Chinese mothers raised their overall pitch less and expanded pitch excursions less than did American mothers. This finding reflects certain constraints on pitch modulation which may be explained linguistically and culturally. Chinese mothers compensated for such constraints through a high proportion of unconstrained modeling sounds. (PCB)

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Melodies in motherese in tonal and nontonal languages: Mandarin Chinese, Caucasian American, and German

Mechthild Papoušek

Max-Planck-Institute for Psychiatry, Munich, F. R. Germany

in collaboration with the

Laboratory of Comparative Ethology, NICHD, Bethesda, Maryland

Mailing Address: Papoušek, M., M.D.
Max-Planck-Institute for Psychiatry
Developmental Psychobiology
Kraepelinstrasse 10
D-8000 Munich 40
F.R.Germany

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A symposium on the "universality and variability of intuitive parental behavior" should include a discussion of melodies in parental speech for a number of reasons. 1. It is widely acknowledged that melodic patterns are the most salient features of parental speech to young infants. 2. These melodic patterns are at the core of the repertoire of intuitive parental care. And 3. they lend themselves - better than any other communicative behavior - to quantitative measurements and structural analyses. This quality makes them an excellent model for comparative analyses of early parent-infant communication across parental sex, across languages and cultures, and even across species.

Therefore, although we have analyzed prelinguistic vocal communication from many aspects, I like to focus exclusively on the melodies in parental speech and report on a series of studies concerning their structure, functions, and determinants. We have combined acoustic structural analyses with pragmatic functional analyses of parental speech to 2- and 3-month-old infants, and applied this approach in comparative studies. Originally, we examined German samples of mothers and fathers with their 3-month-old infants. More recently, we were able to extend our research to mothers from two other cultures, another one with a nontonal language, Caucasian American, and one with a tonal language, Mandarin Chinese.

I begin by briefly summarizing our German data in order to demonstrate the evidence concerning the salience of melodies in parental speech, their structure, functions, and determinants.

A brief look at some of the linguistic aspects of parental speech shows that both, mothers and fathers alike, predominantly used short utterances that carry little linguistic meaning and don't have a clear referent, such as exclamations, calls, interjections, musical, or imitative sounds. In relation

to the immediate interactional context, however, the pragmatic function of these utterances was to promote and maintain conversation-like, playful, and/or imitative interchanges with the infant. Only some 40% of utterances included actual speech, in which the main referent was the infant's state or behavior.

The majority of utterances had 1, 2, or 3 syllables only and were articulated at a slow tempo, particularly in utterances with no lexical meaning. The slow tempo was typically a result of elongation of vowels which in turn allowed for extensive, smooth modulations in pitch.

The resulting melodies differed considerably from adult intonation in a number of ways: 1. We found a prevalence of simple unidirectional contours in two thirds of parental utterances. 2. Increased pitch modulation was reflected in a fourfold expansion of the overall pitch range from the modal speech frequency range of 6 semitones to 24 semitones, as well as in expanded average pitch excursions. On average, there were 7 semitones between the minimum and maximum frequencies of individual utterances. 3. Melodic patterns were repeated significantly more than the wording of utterances by both parents. 4. The most striking feature was a high degree of similarity in repetitive performances of individual melodic patterns. The slide shows a cumulative record of all 44 repetitions of a U-shape pattern that a mother directed to her 2-month-old within a 3-minute dialogue. 5. Parents tended to restrict their melodic repertoire to a limited set of 5 to 6 of such distinctive prototypical patterns.

According to these data, fathers modified the structure of their speech in the very same way as mothers did, except for an unavoidable difference of one octave in pitch. If we now ask about the function of parental melodies they become quite interesting in relation to what is known on infant perceptual and integrative capacities. In the light of this research the acoustic properties

of parental melodies are well matched to the perceptual constraints and preferences of presyllabic infants. The prototypicality of melodies may facilitate infant abstraction and categorization of vocal information and the modes in which they were displayed - slow tempo, frequent repetition, and contingency on infant behaviors - fulfill basic prerequisites for successful learning in young infants. Thus, one function of parental melodies may well be to present the infant with adequate vocal stimulation that the infant can process even at the presyllabic age.

A more difficult question concerns the communicative function or meanings of parental melodies which apparently are not tied to the lexicon, syntax, or grammar of utterances, but may represent independent sources of information. While many authors stress the affective nature of parental melodies, or their role as precursors of adult intonation, we tried to go one step further by analyzing their functional meaning in relation to various contexts of parental care. As the presented contingency table indicates, individual melodic patterns were used preferentially and consistently in relation to different contexts of parental care, such as "encouraging an infant turn", "encouraging visual attention", or "soothing a distressed infant". Through such association, parental melodies become potential carriers of differential information in close relation to the parent's intuitive didactic guidance.

Having reviewed the data on the structure and function of parental melodies, we are still puzzled by the question as to what makes parents predictably adjust their speech and produce these melodies as soon as they start interacting with a presyllabic infant. What are the potential determinants of parental speech adjustments? We are particularly interested to what degree these adjustments are based on cultural heritage or on a biological

preadaptedness. Three results from our previous studies point to a biological basis: the striking recourse to prelinguistic means of communication; the intuitive nature of parental adjustments; and their universality across parental gender.

In order to explore the extent to which parental melodies are influenced by cultural tradition or by the structure of a given language, we extended our studies to samples from two additional cultures, one with a stress language - Caucasian American - and one with a tone language - Mandarin Chinese.

Let me explain to you briefly why we became so interested in mothers with a tone language and, at the same time, clarify some basic terms. I have used the terms "melody" and "pitch" interchangeably in my talk referring to the perceptual attributes of sound frequency in a strictly descriptive, nonlinguistic sense. Likewise, "fundamental frequency" refers to the acoustic correlates of perceived pitch. In contrast, "intonation" and "tone" are used as linguistic terms in the sense that "intonation" refers to the suprasegmental use of pitch on the sentence or phrase level carrying syntactic, semantic, and/or affective meaning. "Tone" is used exclusively to indicate contrastive pitch on the syllable or word level carrying lexical meaning.

English, like many European languages is considered by most authors a typical "stress language" in which pitch is mainly used in relation to emphasis or stress and intonation. In contrast, Mandarin is a tone language in which pitch is used primarily on the syllable level to signal lexical meaning. Mandarin has four tones, a level, a rising, a falling-rising, and a falling tone, plus a neutral tone all of which are loosely tied to five relative pitch levels. Depending on the tone, the syllable "ma" can therefore mean "mother", "hemp", "horse", or "scold", or be used with a neutral tone, e.g.

in duplicated nouns as "mama", or with the function of a final particle.

The structure and role of intonation and stress in Mandarin has been largely unexplored. The most common view is that if there is intonation at all, pitch is allowed to vary only within a limited frequency range in order to avoid distortion of tones and misunderstandings.

Coming back to the purpose of our cross-cultural investigations, the crucial question has been for us: can Chinese mothers produce prototypical melodies similar to the German or American mothers without violating the tone rules of their language? We may speculate that Chinese mothers avoid such "conflict" by either not speaking to their infants or by preferring adult-directed forms of speech or they may adjust to the infant's early perceptual competence in melodic processing in a different way and start teaching lexical tones right after birth. This, for sure, would be the strongest evidence of major cultural determinants. On the other extreme, they may come up with some compromise or even violate the tone rules in favor of the intuitive parental melodies which might be considered the strongest support for our assumption of a primary biological determination.

I am going to present data from 10 Caucasian American and 10 Mandarin mothers. All were videorecorded and audiorecorded during spontaneous interactions with their two-month-old infants at the NICHD, Laboratory of Comparative Ethology. Maternal utterances were transcribed and translated by a Chinese linguist, Shu-fen Hwang, and acoustically analyzed in close collaboration with Dr. David Symmes at the LCE, NICHD. He kindly provided the computer programs that allowed us to digitize maternal utterances, to have them displayed as color sonagrams, to generate and store fundamental frequency contours with a Summagraphics

Bitpad device, to create cumulative records of repetitive patterns, and to average and compare contours across contexts of maternal care and across cultures. Various contexts of parental care (such as "encouraging an infant turn", "confirming or rewarding an infant turn", "promoting imitation", "discouraging infant fussiness", or "soothing a crying infant") were evaluated from both videoanalyses of the interactional context and the lexical content of maternal speech.

Both groups of mothers exhibited a strong tendency to speak to their infants with a slight significant surplus on the part of Chinese mothers (32.4 vs. 25.0 utterances per minute). A total of 4000 utterances from both samples were recorded and evaluated from a total of 140 minutes of interaction time. The average distribution of melodies indicated a strong preference for the simple uni- or bidirectional melodies with no differences between the samples. This tendency corresponds closely to our findings from the German sample. But how did the Chinese mothers manage to do so?

In part, Chinese mothers circumvented the problem by a strong preference for nonverbal, lexically ambiguous utterances. Again, a total of two thirds are those conversation promoting, play promoting, or imitation promoting utterances that we had found in the German mothers. We discovered only one difference between the lexical contents of Chinese and of American or German maternal utterances, namely a significantly higher proportion of modelling sounds in the Chinese.

Next, we take a closer look at the average acoustic structure of prevalent melodic contours, rising and falling, as far as they have been analyzed, and compare them to the average melodic patterns of adult-directed speech of the same mothers from an interview context. In both groups of mothers, we found an overall rise in pitch, smooth, simple contours and expanded

pitch excursions in infant-directed speech. However, American mothers exhibited much wider frequency excursions and a more prominent overall rise in pitch than the Chinese mothers. The same applies to the U-shape and bell contours. This finding confirms our expectation that in a tone language pitch is allowed to vary only within a limited frequency range for purposes other than lexical contrasts.

We investigated the functional meaning of contours as well by comparing the distribution of melodies across different contexts. Again we found overall strikingly similar preferences. The next few slides illustrate, each in a different context, melodic preferences in both groups of mothers, together with sonagraphic examples of the prevalent prototypical melodies. The most frequent context, "encouraging an infant turn", (27% of voiced utterances in both samples) was characterized by a significant peak in the rise contours. As soon as the infant succeeded in a turn (e.g. a smile or vocalization) mothers tended to confirm or reward preferentially with a bell contour. We found transitions to either falling or sinusoidal patterns, most likely dependent upon the emotional emphasis of the mother. When the infant got fussy, the mothers occasionally discouraged infant crying with short, abrupt, staccato-like melodies that typically overrode infants' fussy sounds. Mothers were again using falling, bell, or sinusoidal contours dependent upon the emotional emphasis of the mother. When mothers were soothing their fussy or crying infant, they exhibited a strong preference for extended falling melodies.

No preferences were found when mothers were modelling sounds to their infants, except that they avoided more complex melodies or those that normally are not yet present in the repertoire of a two-month-old. Promoting imitation by presenting model sounds or matching infant sounds was not only twice as frequent in the Chinese sample, as I showed

earlier. It was also the context in which Chinese mothers exhibited the full range of babytalk features. As the modelling context seemed to be more or less free from constraining tone rules, Chinese mothers used higher pitch and more expanded frequency excursions approaching those of the American mothers.

Moreover, in this context, it became obvious to us for the first time that the Chinese mothers did not teach typical Mandarin tones, as they displayed a wide variety of melodic contours on extremely varying pitch levels, in quite the same way as the American or German mothers did. They showed no preference for anything that looked or sounded like a Mandarin tone.

We have just begun to explore in more detail the various strategies that mothers seemed to be using to cope with the interaction between tones and maternal melodies in utterances that included words. We selected a sample of 100 maternal utterances, and asked three Mandarin chinese informants to speak these same utterances, each one in three different conversational contexts: as if talking to another Chinese adult, as if teaching tones to a stranger, and as if talking to a baby. The three versions were then compared to the original maternal utterances. The slide depicts the sonagrams of "mèiméi" and "niúniu" ('little girl' and 'cow') as spoken by the three informants. Two mothers had used these names or nicknames to address their little girls. Both words are duplicated nouns, meimei with a falling 4th tone (the tone on the second syllable turning neutral in this case), and niuniu with a rising 2nd tone. Teaching tones to a stranger led to a nice proportional expansion of the tones in duration and pitch. Talking to an infant, however, resulted in a totally different pattern that, too, was expanded in pitch and duration, but turned into a

simplified contour that was surprisingly similar for both utterances. In the original utterances of the two mothers, we found a variety of simple melodies, in which the tonal information got completely lost.

As surprisingly many mothers were teaching "mama" to their two-month-olds, I wish to show you their models of the word "mama", the correct model of which is depicted in the left upper corner of the slide. What we see is an enormous variety of melodies, many of them rising, due to the inherent context of "encouraging an imitative turn". The lexical tone structures, however, were evidently neglected if not to say violated. Similarly, a closer analysis of more complex verbal utterances suggests that the Chinese mothers did not tend to teach correct pronounciation of lexical tones. It was exceptional to find segmentation and proportional lengthening of tones as typical for the teaching context in our experiment. A more common pattern was a disproportional lengthening of the final syllable. In many adult-directed conversational utterances, the final syllable is a short particle with neutral tone that does not carry lexical meaning. In maternal speech, the neutral tone particles were lengthened and became the carrier of a major part of sentence intonation. At the same time, we found smoothing or flattening of lexical tones in favor of a simplified, exaggerated global intonation contour. These findings suggest that the Chinese mothers followed similar tendencies as the American or German mothers when talking to their infants.

Although such extreme forms of neglect occurred only in a small sample of utterances, they clearly indicate that at least in these utterances Chinese mothers may have been driven more by a propensity for intuitive maternal care than by the rules of their language.

To summarize: When comparing the melodies in the speech of Mandarin Chinese and Caucasian American mothers, we have so far found striking similarity in the overall distribution and average structure of melodic contours, in close contextual links to given forms of intuitive parental care, and in a tendency to neglect lexical tones in favor of pitch modulation. These findings strongly support the notion of a cross-cultural universality of maternal melodies, and indicate a primary biological determination.

On the other hand, we found some significant differences as well, with regard to the extent of these speech adjustments. Chinese mothers raised their overall pitch less and expanded pitch excursions less than American mothers. This finding reflects certain constraints on pitch modulation which may be explained both linguistically and culturally. In any case, Chinese mothers seemed to compensate for such constraints through a high proportion of unconstrained modelling sounds.