

# Does Native Language Influence the Mother's Interpretation of an Infant's Musical and Linguistic Babblings?

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## ABSTRACT

Adachi and Ando (2010) demonstrate that Japanese mothers can interpret a Japanese toddler's linguistically ambiguous vocalizations as either talking or singing, depending on the context sampled. The present study explored whether the same response patterns were intact among mothers, who were unfamiliar with Japanese toddler's vocalizations. Nineteen German mothers listened to the same 50 vocalizations used with Japanese mothers in the earlier study, evaluating whether each vocalization sounded as talking or singing. Results indicated that German mothers interpreted the Japanese toddler's vocalizations taken from infant-directed speech contexts more as though it were talking than as singing and those taken from infant-directed song contexts more as singing than as talking. As a group, German mothers used seven vocal cues in interpreting the vocalizations. Focusing on the individual mother's use of vocal cues, however, only one cue among the seven identified as a group—the number of syllables per s—was used consistently by more than three mothers: The lesser number of syllables per s (i.e., a longer syllable) guided German mother's interpretation toward singing, as found in Japanese mothers. The number of vocal cues used consistently by three or more mothers was greater in Japanese (7 cues) than German (2 cues) samples. Perhaps, the unfamiliarity of the toddler's native language interfered with German mother's consistent use of vocal cues. Nonetheless, the equivalent number of vocalizations interpreted as talking or as singing by German and Japanese mothers may imply something unique in the mother's interpretation of the toddler's vocalization beyond native language.

## I. INTRODUCTION

According to Moog (1968/1976), the infant's vocalizations diverge into two types of babbling: *linguistic* and *musical*. Characteristics of musical babbling have been described by other researchers, for example, as glissando, three-note patterns with unidentifiable pitches, repeated intervals, and repetitions of long-and-short-tone patterns (e.g., Kelley & Sutton-Smith, 1987; Tafuri, 2009; Tafuri & Villa, 2002). Thus, musical babbling is an infant's vocalization that *sounds* musical due to its contour, pitch range, melody, and rhythm, serving as the first step for the spontaneous song development.

According to the literature, musical babbling can be elicited by musical interactions such as infant-directed singing (e.g., Kelley & Sutton-Smith, 1987; Tafuri, 2009), which is a stimulating tool for a mother-child interaction (Falk, 2011; Papousek, 1996). Additionally, it has been claimed that musical babbling is observable more often in a musical than in a non-musical context (e.g., Tafuri & Villa, 2002). However, this claim was not based on acoustical analysis so far. In fact, Adachi and Ando (2010) found no differences between a Japanese toddler's spontaneous vocalizations recorded during the parent's verbal interactions and those recorded during musical interactions in terms of their pitch, pitch range,

contour, rhythm, and the number of syllables. However, Adachi and Ando found that Japanese mothers interpreted the toddler's vocalizations taken from musical contexts more as "singing" than as "talking," whereas those taken from verbal contexts were classified more as "talking" than "singing." In other words, the claim that musical babbling can be observed more in musical than in non-musical contexts appears to be true on only perceptually. The next question is whether this phenomenon is bound to one's native language. The purpose of the present study was to examine this issue by replicating Experiment 2 of Adachi and Ando (2010), in which Japanese mothers evaluated a Japanese toddler's babbling, with German mothers.

## II. METHOD

### A. Participants

Participants were 19 German mothers, 29-54 ( $M = 36.22$ ,  $SD = 7.04$ ) years of age, recruited at child-care facilities in a Munich suburban area. Of those, 16 mothers had 3- to 8-year-old children, two had teenagers, and one had adult children. Eleven mothers were involved in music activities such as playing an instrument and/or singing in a choir; furthermore, six mothers sang for their own pleasure, and two were not involved in music at all. Twelve mothers had 3-16 years of compulsory music education. All participants were native German speakers, one reported to be a German-Italian bilingual speaker from childhood on. The participants volunteered in the experiment, they were given a "Certificate of Participation" and small gifts as an incentive. There was one additional participant, but she was excluded from the sample because of her Japanese language skill.

### B. Stimuli

The stimuli consisted of 50 vocal samples (0.81-5.25 s,  $M = 1.77$ ) taken from the recordings of a 19-month-old Japanese boy's vocalizations that could not be identified as specific Japanese words, 38 derived from infant-directed speech contexts and 12 from infant-directed singing contexts at home (Adachi & Ando, 2010). The 50 vocal samples were randomly ordered and arranged into a CD. Two additional vocal samples of the same boy were prepared as practice stimuli, arranged into another CD. To evaluate order effects, two orders of the 50 stimuli were prepared.

### C. Procedure

The experiment was conducted at a child-care facility in a suburban area of Munich, Germany. Participants were tested individually or in groups from two to nine. After reading and signing a consent form, participants listened to each of the 50 stimuli. Stimuli were played from the DVD drive of a

Hewlett-Packard laptop computer. Two loudspeakers (Creative SBS35) were used to present the stimuli at a comfortable loudness. The mothers interpreted how the vocalizations sounded by using the following 4-point scale: 1 (talking), 2 (more talking than singing), 3 (more singing than talking), and 4 (singing). After the listening experiment, the participant responded to a questionnaire where they were asked to fill in some demographic information and their musical experience. Additionally, they gave some information on child-care and singing activities when their children were young. The entire experiment took approximately 30 min.

### III. RESULTS

#### A. The Overall Distribution of German Mothers' Interpretation

Preliminary analyses showed no effects of musical experience, as found in Japanese mothers' data (Adachi & Ando, 2010). Figure 1 shows the distribution of German mothers' interpretation of Japanese toddler's vocalizations across two contexts from which the vocal samples were recorded originally. Approximately 60% of the vocalizations from infant-directed speech were interpreted as *talking* and approximately 52% of those from infant-directed songs were interpreted as *singing*. This contextual effect on German mothers' interpretations of the Japanese toddler's vocalizations was significant,  $\chi^2(1, N = 949) = 9.55, p = .02$ .

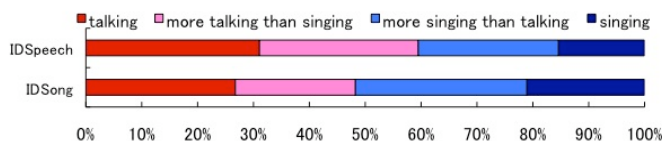


Figure 1. The distribution of German mothers' interpretation of Japanese toddler's vocalizations sampled during infant-directed speech and those during infant-directed song ( $n_{sp} = 721, n_{sng} = 228$ ).

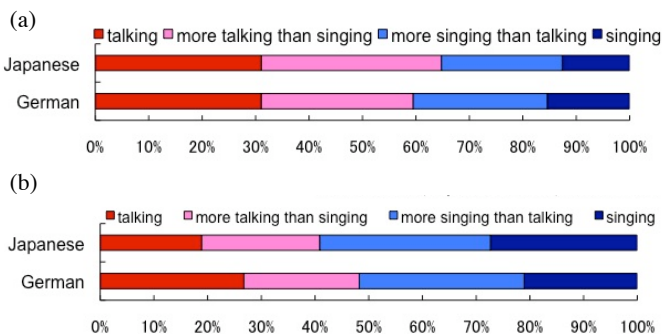


Figure 2. Cross-cultural comparisons of the distribution of the mother's interpretation of Japanese toddler's vocalizations sampled during infant-directed speech (a:  $n_G = 721, n_J = 836$ ) and those during infant-directed song (b:  $n_G = 228, n_J = 264$ ).

To investigate whether the German mother's interpretation was different from the Japanese mother's, we conducted a chi-square test against a cross-tab between the distributions of the mother's interpretations from two countries for each context.<sup>1</sup> Although the contrasting distributions of the Japanese mother's interpretations appeared to be clearer than those of the German mother's, no statistical differences were

found in their interpretations either of the vocalizations from infant-directed speech (Figure 2a),  $\chi^2(1, N = 1557) = 6.63, p = .08$ , or of those from infant-directed song (Figure 2b),  $\chi^2(1, N = 492) = 5.37, p = .15$ .

#### B. The Overall Use of Vocal Cues in the German Mother's Own Interpretation of the Japanese Toddler's Vocalizations

Next, we explored whether the German mother's own interpretation of the Japanese toddler's vocalizations (regardless of the original context from which those vocalizations were sampled) was related to particular vocal features. For this analysis, we first converted the original 4-point-scale data to a binary form by combining 1 (*talking*) and 2 (*more talking than singing*) as "talking" and 3 (*more singing than talking*) and 4 (*singing*) as "singing." We then calculated mean values of the following vocal features, originally measured in Adachi & Ando (2010), based on the individual mother's interpretation of each vocalization: mean  $F_0$  (Hz), minimum  $F_0$  (Hz), maximum  $F_0$  (Hz), vocal range (semitone), duration (s), the number of syllables, the number of syllables per s, upward contour (1 as *absent*, 2 as *present*), downward contour (1 as *absent*, 2 as *present*), up- and downward contour (1 as *absent*, 2 as *present*), down-and upward contour (1 as *absent*, 2 as *present*), horizontal contour (1 as *absent*, 2 as *present*), isochronous rhythm (1 as *absent*, 2 as *present*), long-and-short-tones (1 as *absent*, 2 as *present*), and repetition of long-and-short-tones (1 as *absent*, 2 as *present*). The quantitative data (i.e., pitch, vocal range, duration) were obtained by means of Praat for Windows. The binary data (i.e., *absent* or *present*) and the number of syllables were determined by four individual evaluators; we used data at least three evaluators agreed. Finally, we compared the mean values of each measure obtained for the vocalizations interpreted as *talking* with those interpreted as *singing*. We used Wilcoxon signed ranks test because data were not normally distributed. To reduce type I error in 15 comparisons, we adopted Bonferroni's correction (overall  $\alpha = .1$ , subset  $\alpha = .007$ ).

Results showed that the number of syllables was greater for the vocalizations interpreted as talking ( $M = 4.51, SD = 0.18$ ) than for those interpreted as singing ( $M = 4.06, SD = 0.23, Z = -3.30, p = .001$ ). The number of syllables per second was also greater for the vocalizations interpreted as talking ( $M = 2.91, SD = 0.12$ ) than for those interpreted as singing ( $M = 2.37, SD = 0.14, Z = -3.82, p < .0001$ ). The vocalizations interpreted as talking ( $M = 1.57, SD = 0.06$ ) included more upward contours than those interpreted as singing ( $M = 1.45, SD = 0.11, Z = -3.06, p = .002$ ), whereas those interpreted as singing ( $M = 1.80, SD = 0.20$ ) included more horizontal contours than those interpreted as talking ( $M = 1.73, SD = 0.04, Z = -2.74, p = .006$ ). The vocalizations as talking ( $M = 1.61, SD = 0.06$ ) included more isochronous rhythm than those as singing ( $M = 1.49, SD = 0.08, Z = -2.96, p = .003$ ). Moreover, the vocalizations interpreted as singing appeared to have longer duration ( $M = 1.88, SD = 0.15$ ) and lower mean pitch ( $M = 411.47, SD = 12.17$ ) than those interpreted as talking ( $M = 1.68, SD = 0.13$  for duration,  $M = 424.10, SD = 8.78$  for mean  $F_0$ ), both of which were approaching to be significant,  $Z = -2.62, p = .009$  (duration), and  $Z = -2.46, p = .014$ . (mean  $F_0$ ), respectively.

### C. The Individual Mother's Use of Vocal Cues and Cross-cultural Comparisons

The above analyses indicate an overall tendency of the German mothers' use of vocal cues as a group. This would not mean that every mother used the same vocal cues in the same way. Some mothers would use more cues than others, as found in Japanese mothers (Adachi, 2010a) and fathers (Adachi & Ding, 2010) as well as Japanese college students (Adachi, 2010b, 2011). To examine how individual mothers used the Japanese toddler's vocal cues in differentiating singing from talking, we conducted a variable selection of logistic regression (backward elimination, with  $\alpha = .05$ ) for each mother's data. With this procedure, we identified a list of cues that contributed to the individual mother's interpretation of the 50 vocalizations.

11 out of 19 German mothers used at least one vocal cue consistently to identify vocalizations as singing or talking. Of the seven vocal features described in the previous section (see "B. The Overall Use of Vocal Cues"), only one vocal cue—the number of syllables per second—was identified as a cue guiding the interpretations of seven mothers. Another cue—maximum  $F_0$ —was also identified as a cue used by three mothers, but this particular cue was not identified as vocal features used by German mothers as a group. The use of other cues was inconsistent across mothers, or it was consistent but among fewer mothers.

Unlike German mothers, whose individual use of cues generally lacked coherency among themselves, Japanese mothers' use of vocal cues was relatively consistent across individuals. Seven vocal cues—mean  $F_0$ , minimum  $F_0$ , maximum  $F_0$ , duration, the number of syllables, the number of syllables per second, and the presence of upward contours—were used in the same way by three or more Japanese mothers. The number of cues used consistently among three or more mothers was greater in Japanese (7 cues) than in German (2 cues) samples,  $\chi^2(1, N = 30) = 3.97, p = .046$ .

### D. Other Cross-cultural Comparisons between German and Japanese Mothers

To explore effects of native language on the mother's interpretation of the infant's vocalizations further, we compared the number of vocalizations identified as talking and those as singing between German and Japanese samples by means of a Mann-Whitney test. Results indicated no significant differences between these groups of mothers. More specifically, the number of vocalizations identified as talking ranged from 15-41 in German mothers and from 17-40 in Japanese mothers, (median: 29 and 30, respectively). Likewise, the number of vocalizations identified as singing ranged from 9-38 in German mothers and from 10-33 in Japanese mothers (median: 21 and 20, respectively).

## IV. DISCUSSION

The overall distribution of the German mothers' interpretation of the Japanese infant's vocalization was similar to that of the Japanese mothers': The infant's vocalizations elicited during infant-directed song tended to be interpreted as *singing* and those elicited during infant-directed speech as *talking*. This pattern of interpretations has been confirmed in Japanese fathers (Adachi & Ding, 2011), in Japanese college

students with (Adachi, 2011) and without child-care experiences (Adachi, 2010b), and in Chinese college students (Ding & Adachi, 2011). With the addition of the present results, we can conclude that the vocalizations tested in this experiment were interpreted in the same way by the mothers regardless of native language. Whether the same pattern of interpretation is evident for vocalizations of other infants needs further research. Overall, a higher amount of vocalizations was judged to sound as singing. We identified some acoustic cues that guided German and Japanese mothers' judgment about the infant's vocalization. The most consistent cue seems to be the number of syllables per second. This cue has been proven important in every sample studied so far (Adachi, 2010a, 2010b, 2011; Adachi, Ding, 2011; Ding & Adachi, 2011): The fewer number of syllables per second—that is, longer syllables—appears to be associated with the adult's interpretation of singing-like vocalizations, regardless of native language.

The present study also confirmed that the use of vocal cues can differ by individuals and that the group tendency in the use of vocal cues would not necessarily represent how individuals interpret the infant's vocalizations, as found in Japanese mothers (e.g., Adachi, 2010a), fathers (Adachi & Ding, 2011), college students (Adachi, 2010b, 2011), and Chinese college students (Ding & Adachi, 2011). In the case of the German mothers, the fewer number of syllables per second was interpreted as singing as well as a group tendency and as an individual cue, but the other cues were not consistent between the group and the individual tendencies.

In focusing on the individual use of cues in the maternal interpretation of the infant's vocalization, Japanese mothers used a greater number of vocal cues consistently than did German mothers. Even though the toddler's vocalizations were not discernable as Japanese words, many vocal features such as vowels, consonants, and rhythm specific to Japanese language must have benefited the Japanese mother's use of these cues in interpreting vocalizations as *talking* or *singing*. German mothers, on the other hand, did not have prior access to Japanese *talking* vocalizations, and they could either try applying their knowledge of the German infant's *talking* vocalizations or try guessing the unfamiliar infant's vocalizations. In either case, German mothers did not have a common ground, i.e., schema or prototype of a Japanese infant's vocalizations, which is reflected in the fewer number of German mothers sharing the same vocal cues. It will be an issue for future research to compare how German and Japanese mothers interpret a German infant's vocalizations and how they use vocal cues.

Despite such cross-cultural differences, the mothers from two linguistic backgrounds interpreted approximately the same number of the Japanese toddler's vocalizations as talking or singing. Since Japanese fathers interpret fewer toddler's vocalizations as *singing* than do Japanese mothers, the German mother's performance equivalent to their Japanese counterpart may imply that there may be something beyond benefits or disadvantages from native language that uniquely operates in the mother's responses to the infant's vocalization.

## NOTE

<sup>1</sup>For the current cross-cultural comparisons, we used the latest Japanese data with 23 Japanese mothers (Adachi, 2010a, 2011; Adachi & Ding, 2011), i.e., one additional sample to the original 22 reported in Adachi & Ando (2010).

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