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Mother–Infant Interaction During the First 3 Months: The Emergence of Culture-Specific Contingency Patterns

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This study analyzed German and Nso mothers' auditory, proximal, and visual contingent responses to their infants' nondistress vocalizations in postnatal Weeks 4, 6, 8, 10, and 12. Visual contingency scores increased whereas proximal contingency scores decreased over time for the independent (German urban middle-class, $N = 20$) but not the interdependent sociocultural context (rural Nso farmers, $N = 24$). It seems, therefore, that culture-specific differences in the modal patterns of contingent responsiveness emerge during the 2nd and 3rd months of life. This differential development was interpreted as the result of the interplay between maturational processes associated with the 2-month shift that are selectively integrated and reinforced in culture-specific mother–infant interaction.

Caretakers' contingent responsiveness to their infants' communicative signals is a key feature of early parenting. Mothers intuitively react to infants' signals within a short period of time, normally less than a second (Keller, Lohaus, Völker, Cappenberg, & Chasiotis, 1999; Papoušek & Papoušek, 1987). Infants, in turn, are motivated to detect these contingencies; this behavior is self-rewarding in that it gives rise to positive affect (Watson, 1985). In detecting these contingencies, infants begin to perceive themselves as causal agents whose behavior directly affects their social environment. This knowledge has fundamental implications for infants' subsequent cognitive and socioemotional developmental processes (cf. Bigelow, 1998; Keller, Kärtner, Borke, Yovsi, & Kleis, 2005; Tarabulsy, Tessier, & Kappas, 1996).

Contingent responsiveness can be regarded as a universal, evolutionarily shaped component of parenting that is realized in context-sensitive ways. Support for this assumption comes from studies that explored the universality of contingent responsiveness by looking at cross-cultural similarities and differences in caretakers' responses. The general consensus is that the overall level of contingent responsiveness is similar across cultural contexts; however, there are differences in terms of the way in which caretakers react contingently (Bornstein et al., 1992; Fogel, Toda, & Kawai, 1988; Kärtner et al., 2008; Richman, Miller, & LeVine, 1992). For example, Richman et al. (1992) found that Gusii mothers from Western Kenya were predominantly physically responsive while Euro-American middle-class mothers were predominantly verbally and visually responsive. In a similar study, Kärtner et al. (2008) compared the contingent responses of caretakers from independent, autonomous-relational, and interdependent sociocultural contexts. Kärtner et al. found that caretakers from independent sociocultural contexts addressed the infants' sense of sight significantly more often than did caretakers from autonomous-relational or interdependent contexts. Infants from interdependent contexts, on the other hand, experienced significantly more proximal contingent responses addressing the vestibular sense or the sense of touch. Kärtner et al. argued that it was the difference in the caretakers' broader sociocultural orientation and cultural embedment that led to these modal differences in contingent responsiveness. Other researchers have offered similar explanations, such as different norms of interaction (Richman et al., 1992) or differences in cultural beliefs (Fogel et al., 1988), to

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account for cross-cultural variation in contingent responsiveness.

There is some empirical evidence for a functional link between the dominant sociocultural orientation, actual parenting behavior, and child development. Keller, Yovsi, et al. (2004), for example, have shown that culturally informed caretaking behavior fosters desirable developmental outcomes. Specifically, Keller, Yovsi, et al. found that proximal caretaking, mainly in the form of body contact, during mother–infant interaction when infants were 3 months old led to earlier development of compliance and obedience in the toddlers' 2nd year. Both proximal caretaking and obedience of toddlers are highly valued in interdependent sociocultural contexts (Keller, 2007; Ogunnaike & Houser, 2002; Whiting & Pope Edwards, 1988). In contrast to proximal caretaking, distal parenting, mainly in the form of object stimulation and mutual gaze, led to earlier development of the toddlers' autonomous self-concept as assessed by mirror self-recognition. Both distal parenting and toddlers' autonomy are highly valued in predominantly independent sociocultural contexts (Keller, 2007; LeVine, 1994; Richman et al., 1992).

As described above, parents from interdependent and independent sociocultural contexts differ in their contingency patterns and, more generally, in their parenting behavior. For example, German middle-class families have a predominantly independent sociocultural orientation, whereas rural Nso families have a primarily interdependent sociocultural orientation (cf. Kärtner et al., 2008; Keller, 2007; Yovsi, 2003). The Nso, an ethnic group living in a mainly subsistence-based agrarian ecology in Cameroon, socialize their children toward obedience, respect for elders, cooperation, and social responsibility (Nsamenang, 1992). Obligation between kin people is an integral and institutionalized part of Nso morality and daily life (Goheen, 1996) and parents foster their children's integration into a hierarchically structured social setting (Nsamenang & Lamb, 1994).

German middle-class mothers, in contrast, socialize their children toward individuality, autonomy (Keller, 2007), and self-reliance (LeVine & Norman, 2001). Mothers value exclusive dyadic interaction and believe that children need to spend time on their own in order to become more independent (Keller, Hentschel, et al., 2004; Keller, Voelker, & Yovsi, 2005). Based on these differences in sociocultural orientation, we hypothesized that in the 3rd month of life, Nso infants would experience more proximal contingent responses addressing the sense of touch and the vestibular sense and less visual contingencies than would infants from the German middle-class sample. Across modalities, however, mothers from the two sociocultural contexts should show approximately the same amount of contingent responses to their infants' signals; that is, only the modality patterns of the contingent responses should differ between the groups.

The First 3 Months: Continuity of Culture-Specific Patterns or Differential Developmental Change?

Given that the majority of studies of contingent responsiveness focuses on infants who are at least 3 months old, it is as yet unknown whether culture-specific manifestations are present from birth or whether different patterns emerge across the infants' first few months of life. In this way, culture-specific contingency patterns could either be conceptualized as (a) a continuous behavioral response informed by broad and static cultural scripts that guide mothers' behavior or (b) the outcome of a more dynamic, culture-specific interplay of the infants' developing communicative competencies and maternal responses.

Research on the early development of contingent responsiveness is scarce and offers mixed results, partly in support of the continuity hypothesis and partly in support of the developmental change hypothesis. With respect to continuity, the assumption that mothers' contingent responsiveness is a relatively stable feature of mother–infant interaction was first discussed by Watson (1985) and Stern (1985). Both authors argued that social interaction creates default contingency levels through familiarization and that these contingency levels are subsequently reflected in infants' responses to new social stimuli. More recently, Bigelow and colleagues provided empirical evidence in support of the notion of continuity of contingent responsiveness (Bigelow, 1998; Bigelow & DeCoste, 2003; Bigelow & Rochat, 2006). The authors found that 2-month-old infants were most responsive to strangers who showed similar levels of contingent responsiveness as the infants' own mothers (Bigelow & Rochat, 2006). These results indicate that infants expected specific contingency levels, which implies that the mothers' behavior had been sufficiently continuous as to build up these expectations in their infants. Further support for the continuity hypothesis comes from Hsu and Fogel (2003), who found that from postnatal Week 4 to Week 24 there was no effect of age on maternal behavioral actions (verbal/vocal, facial expression, touch, and head

movement) in response to infants' nondistress vocalizations (NDVs). Taken together, these results suggest that, at least over short periods of time, mothers' responsiveness is reasonably continuous.

Evidence for developmental change in contingent responsiveness comes from research examining the 2-month shift. The 2-month shift refers to the period near the end of an infant's 2nd month of life wherein there is a developmental change that marks a qualitative shift in the way in which the infant interacts with social partners and expresses himself or herself (Emde, 1984). Following this shift, infants spend more time in an alert active state (Wolff, 1987), their ability to maintain visual attention increases (Haith, Bergman, & Moore, 1977), and they start smiling socially (Wolff, 1987). There have been several studies that have demonstrated that these changes in infants affect mothers' responsiveness. First, Lavelli and Fogel (2005) found that mothers reacted contingently by talking and smiling in response to their infants' smiles and cooing more during the 2nd and 3rd months than in the 1st month. Second, Symons and Moran (1994) found that there was a steady increase in mothers' contingent smiles in response to infants' smiles from the 2nd to the 6th month. This result is inconclusive, however, as the authors did not report inferential test statistics for the increase. Last, Lavelli and Fogel (2002) have shown that interdyadic differences in face-to-face communication, especially in active engagement between mother and infant, were most likely to emerge during the crucial developmental transition period, that is, toward the end of the 2nd month. Based on these findings, we hypothesized that if mothers' contingency patterns change across the first 3 months, then these changes should coincide with the occurrence of the 2-month shift as indexed by the infants' awake alertness and gazing pattern (especially looks directed at their mothers).

The findings on developmental change in contingent responsiveness, as discussed above, were mostly related to distal aspects of mother–infant interaction, that is, smiling and gazing patterns. These patterns are of central importance in predominantly independent sociocultural contexts. Cross-cultural research has demonstrated that face-to-face interaction does not have the same prevalence and may not have the same meaning across different sociocultural contexts (Keller, 2007). This difference in prevalence and meaning across contexts may have significant implications for the mother's and especially the infant's behavior during early face-to-face interaction. For example, Lavelli and Fogel (2005) showed that mothers' expressions amplified and organized infants' patterns of attention and emotion in relatively stable sequences of mother–infant face-to-face communication in the 3rd month. If face-to-face interaction is less prevalent, however, the development of these stable sequences may be more characteristic of dyads from predominantly independent sociocultural contexts. The question remains as to whether the 2-month shift takes the same form in the interdependent sociocultural context, that is, whether there is a comparable increase in the infants' awake alertness and looking at their mothers. What are the implications of this result for mothers' contingent responsiveness? We addressed these two issues in the present study.

The overarching goal of the present study was to examine the development of cross-cultural modal differences in caretakers' patterns of contingent responsiveness. To do this, we examined the auditory, proximal, and visual contingent reactions that mothers from two different sociocultural contexts (independent and interdependent) show in response to their infants' NDVs in postnatal Weeks 4, 6, 8, 10, and 12. There are three specific hypotheses and two exploratory research questions. First, the overall level of contingent responsiveness should be continuous across time and should not differ between sociocultural contexts. Second, in the 3rd month, infants from the independent sociocultural context should experience more visual contingencies and less proximal contingencies than should infants from the interdependent sociocultural context. Third, contingency patterns should reflect changes associated with the 2-month shift. More specifically, the proportion of mothers' visual contingencies should increase with changes in their infants' awake alertness and gazing patterns. Furthermore, we explored whether the 2-month shift in awake alertness and infants' gazing occurred to the same degree for infants from both sociocultural contexts and whether the consequences for their mothers' contingent responsiveness were similar for the two groups. Finally, we analyzed the stability of contingent responsiveness, the provision of face-to-face context, and the infants' gazing at their mothers' faces across the infants' 2nd and 3rd months in order to learn more about the behavioral organization of early mother–infant interaction. Since little is known about this issue, we acted on the assumption that stabilities should be reasonably high in both sociocultural contexts.

In order to keep the procedure for assessing mother–infant interactions ecologically valid, mothers

were not constrained to a face-to-face interaction but were free to choose a typical setting for interacting with their infants. Rochat (2001) and others (e.g., Jaffe, Beebe, Stanley, Crown, & Jasnow, 2001; Watson, 1985) argue that contingency levels are embedded in face-to-face interactions during mother–infant routines. Following this logic, we would expect infants from interdependent contexts to experience less contingent responses. Kärtner et al. (2008), however, argue that caretakers' contingent responsiveness does not presuppose face-to-face interaction. The results of their study showed that, independent of differences in the extent of caretakers' provision of face-to-face interaction, the overall contingency levels across distal (vocal/verbal, smile, facial expression) and proximal (body contact, body stimulation) modalities were similar across sociocultural contexts.

Regarding the type of infant signals that mothers respond to, a number of studies have shown that, compared to several nonverbal behaviors, infants' NDVs constitute the most salient signal for caretakers (Bornstein et al., 1992; Hsu & Fogel, 2003; Van Egeren, Barratt, & Roach, 2001). This is a consistent finding across sociocultural contexts as diverse as a rural Nso community living in the Bantu grass fields in the North Western province in Cameroon or urban middle-class families from Berlin or Los Angeles (Kärtner et al., 2008).

Method

Participants

Twenty families from Münster, a medium-sized city in Northern Germany, and 24 Nso families living in small villages around Kumbo, Cameroon, participated in the present study. In Germany, the mean age of first-time mothers was approximately 29 years and the fertility rate was 1.4 children born per woman in the last 10 years (Statistisches Bundesamt, 2008). In German middle-class families, infants spend most of their time at home with their mothers during the 1st month. Older siblings go to day-care facilities or nursery school in the mornings. The role distribution in most German families is still traditional in that it is mostly the mothers who take care of the infants while the fathers are at work (Keller, 2006; Keller, Zach, & Abels, 2005).

The Nso sample was recruited from Kikaikelaki, a village near Kumbo, Bui Division of the Northwest Province of Cameroon. In 2004, the average life expectancy in Cameroon was 48.0 years and the fertility rate was 4.6 children born per woman (Central Intelligence Agency, 2008). The mean age of first-time Nso mothers was approximately 19.8 years in 2003 (Yovsi, 2003). The majority of the Nso population live in village communities where subsistence is a combination of communal efforts and endeavors from all family members, including children (Yovsi, 2003). Men achieve high social status through the possession of *keng* (wealth) in the form of raffia palms, coffee plantations, forests, and houses. In Kikaikelaki there are denominational primary schools and most children end their education at the elementary level (Class 7) at, on average, 13–14 years. There are health centers in the villages but they lack infrastructure and most people prefer traditional medicine. Nso villages are made up of several compounds, consisting of houses grouped around a central yard. The settlement pattern is patrilocal and every male owns land within the lineage territory where he builds and settles with his family. The rural Nso have an extended family system of three or more generations. Families share everyday activities, including child care. Thus, children are socialized in a dense social network including parents, siblings, relatives, grandparents, and neighbors. Child care is a communal responsibility; after the birth of a child, everybody in the community has an obligation toward his or her care and social development (Nsamenang, 1992; Yovsi, 2003). Although the German middle-class and the rural Nso families differ in terms of the size of the social networks in which children are socialized, in both of the sociocultural groups the mother is the primary caregiver during the first 6 months of life (Yovsi, 2003).

All of the mothers were first contacted during the last trimester of pregnancy through a pediatric hospital in Münster and through the health centre in Kumbo. In the rural Nso community, mothers were informed only after the lineage heads approved participation. Interested mothers participated if their family heads consented.

There were 50 families in the original sample, however, six Nso families were excluded for equipment or procedural error ($N = 4$) or because two or more observations were lacking ($N = 2$), leaving a total sample of 44 families. Infant gender was balanced across samples (Münster: 45% girls, Nso: 54% girls). The Nso mothers were slightly younger ($M = 27.40$, $SD = 8.15$ years) than were the mothers from Münster ($M = 30.70$, $SD = 3.76$ years), $t(42) = 1.67$, $p > .10$, $d = 0.51$. All of the mothers from Münster and 33% of the Nso mothers were first-time mothers, $\chi^2 = 20.95$, $p < .01$. The Nso mothers had received less formal education ($M = 8.00$,

SD = 1.91 years) than had the mothers from Münster (*M* = 14.35, *SD* = 3.23 years), $t(42) = 8.09$, $p < .01$, $d = 2.45$. According to our sociostructural approach to culture, these patterns of sociodemographic differences are constitutive of the different sociocultural environments (Keller, 2007).

Procedure

After the infants' birth, local research assistants made appointments with and visited mothers at home when the infants were 4, 6, 8, 10, and 12 weeks of age (± 2 days). After the assistant had explained what the study entailed, the mothers, who were the primary caretakers in all instances, were instructed in their native language (German or Lamnso) to interact with their infants as they would normally do. The mothers were free to choose a typical setting. They were, however, asked not to move around too much and not to include others in the interaction. The interaction was videotaped for 10 min (*M* = 9 min 24 s, *SD* = 48 s) using a hand-held camera with a built-in microphone at a distance of approximately 2–3 m. The research assistants made sure that the infants were awake, fed, and not crying before filming began. Assessments with the Nso mother–infant dyads were mostly done outside the house, which is reflective of their daily family routines. A questionnaire concerning sociodemographic information was also administered during the first visit.

Coding

In order to analyze the caretakers' levels and patterns of contingent responsiveness we applied an event-coding approach. In Step 1, a pair of trained students identified the onset and offset of infant sounds for the whole 10 min. A new vocalization was coded when there was a pause of more than 1 s. The identified sounds were then evaluated according to type, intensity, and, in the case of vocalizations, valence. Three types of infant sounds were differentiated: (a) vocalizations, defined as all voiced articulations; (b) vegetative sounds such as sneezes, coughs, and hiccups; and (c) effort sounds, defined as sounds that occur in combination with movements or other efforts such as grunts or motor effort sounds. The intensity of infant sounds was coded as belonging to one of three categories: (a) low, defined as sounds that were uttered with low intensity, that is, hardly audible; (b) high, defined as sounds that were subjectively perceived as loud; or (c) medium, defined as sounds that were neither low nor high in intensity. The valence of vocalizations was judged as either: (a) negative if it was subjectively perceived as negative in hedonistic tone, such as whining, fussing, crying, sighing, and other sounds of discomfort; (b) positive if it was perceived as positive in hedonistic tone, such as sounds of happiness or laughing; or (c) neutral if it was neither negative nor positive, such as a-sounds or babbling.

With respect to interrater reliability, 21% of the sample was coded by both coders. For infant sounds, the proportion of agreement for onsets relative to the total number of onsets coded by at least one of the coders, within a time tolerance of 1 s between coders, was .77. Reliabilities were medium to high for the type ($\kappa = .79$), valence ($\kappa = .79$), and intensity ($\kappa = .81$) of the infants' sounds.

In the main analysis, we focused on the infants' NDVs, defined as neutral vocalizations of low or middle intensity (cf. Hsu & Fogel, 2003; Hsu, Fogel, & Messinger, 2001). On average, infants uttered 30.3 NDVs (*SD* = 21.6) per 10 min, which had a mean duration of 1.44 s each (*SD* = 3.30) and accounted for 55% of all infant sounds. These values were similar across cultural context and age. All other sounds were excluded for theoretical and methodological reasons. Theoretically, vegetative (13.0% of all infant sounds) and effort (19.4% of all infant sounds) sounds cannot be attributed to the infant's initiative; contingent responsiveness concerns the infant perceiving himself or herself as a causal agent. Furthermore, preliminary analyses indicated that caretakers reacted differently to negative (7.4% of all vocalizations), positive (4.9% of all vocalizations), and highly intense (4.5% of all vocalizations) vocalizations. As these vocalizations were distributed unequally across dyads, ages, and cultural contexts, differences in contingency patterns between participants or cultural groups would, in part, be caused by differential distributions of valence and intensity.

Based on the fact that maternal responses are most likely to occur in the 1st second after the infants' signal (Bloom, Russell, & Wassenberg, 1987; Keller et al., 1999; Papoušek & Papoušek, 1987), we defined a latency window of 1 s for contingency (cf. Bigelow, 1998; Bigelow & Rochat, 2006; Hsu & Fogel, 2003; Kärtner et al., 2008; Keller, Yovsi, et al., 2004; Keller et al., 2008). In other words, the caretakers' response had to occur within the latency window that begins with the onset and ends 1 s after the offset of the vocalization to be considered contingent.

In Step 2, the coders coded the caretakers' contingent responses. A caretaker's action was coded as contingent if the caretaker either initiated an action that was not shown before (*addition*) or changed the rhythm or the intensity of an ongoing action (*modification*; cf. Hsu & Fogel, 2003; Keller & Schölmerich, 1987). All other cases were coded as *no reaction*. The coding was carried out separately for the different senses that the caretakers' contingent response might have addressed: (a) *auditory contingencies* addressing the infants' sense of hearing were provided by the caretakers' verbalization, vocalization, and other sounds, for example, tongue clicking; (b) *proximal contingencies* addressing the sense of touch and the vestibular sense were provided by body stimulation defined as touching or stimulating the infant with the hands (e.g., stroking or patting) or the face (e.g., kissing) or by body contact; or (c) *visual contingencies* addressing the sense of sight were provided by the caretakers' gaze, smile, or facial expression (e.g., raised eyebrows and/or mouth wide open) or by using an object (e.g., a toy).

The 1 s before the onset of each NDV served as a baseline against which the caretakers' behavior was evaluated. In all cases, auditory, proximal, and visual contingencies were coded independently. For example, a mother might modify her vocal/verbal behavior and start smiling in response to an infant's NDV. Interrater reliabilities were computed on the basis of the same 21% that were coded by both coders. Cohen's kappas were medium to high for the modalities of the caretakers' contingent responses (body stimulation: $\kappa = .87$, body contact: $\kappa = .84$, gaze: $\kappa = .76$, smile: $\kappa = .85$, facial expression: $\kappa = .72$, vocalization: $\kappa = .89$, and object stimulation: $\kappa = .92$).

Approximately 4.5% of the NDVs were excluded from further analyses because not all of the caretakers' modalities could be coded (e.g., face covered by hair). In the final analysis, we computed a proportional score that indicated the *overall* contingency experience for each infant, that is, the percentage of NDVs that were responded to contingently by addressing at least one of the infant's senses. To analyze the similarities and differences in the patterns of contingent responses across the infants' age and sociocultural context, we computed three proportional scores that indicated the percentage of all contingent responses that were *auditory*, *proximal*, or *visual*.

In Step 3, a second pair of coders coded face-to-face context and the infants' alertness and gaze. In order to do this, we used an interval coding approach based on 10-s intervals. For each 10-s interval, the coders decided whether or not mothers created a context that was favorable for face-to-face interaction for at least half of the interval. A favorable context was defined as one in which the mother turned toward the infant and positioned herself and the infant in such a way that the mother's face was situated not more than 45° off her infant's optical axis. In addition, two indicators of the 2-month shift were coded: (a) the relative number of 10-s intervals in which the infant was alert, that is, when the infant did not show any signs of sleepiness (repeated yawning and/or drooping eyelids), and (b) the infants' gazing at their mothers' faces. Onset and offset of infants' gazing at their mothers' faces were coded during episodes where mothers had established face-to-face context and infants were alert. Interrater reliabilities that were computed on the basis of 21% of the data were medium to high for face-to-face context ($\kappa = .86$), alertness ($\kappa = .72$), and infants' gaze ($\kappa = .78$). The final scores for *face-to-face context* and *alertness* were the relative frequencies (i.e., proportions) of 10-s intervals in which the coding criteria applied so that the values represent the proportion of intervals during which the mother provided a favorable face-to-face context or the infant was awake, respectively.

For the infants' gazing at their mothers' face, we computed two scores. The first score, mutual gaze_{fav}, was defined as the duration of infants' gazing at their mothers divided by the absolute frequency of 10-s intervals in which mothers established face-to-face context *and* infants were alert multiplied by 10 s. The latter multiplication is an approximation of the total duration of context favorable for mutual gaze, that is, episodes where mothers had established face-to-face context and infants were alert. This score (mutual gaze_{fav}) indicates the duration of mutual gaze relative to the duration of episodes in which mothers established face-to-face context and infants were alert. The second score, mutual gaze, is the duration of infants' gazing at their mothers divided by the duration of the full interaction episode. Because infants' gaze was only coded during sequences where mothers established face-to-face context, this score approximates the duration of mutual gaze relative to the duration of the entire episode.

Results

Plan of Analysis and Missing Data Treatment

In order to analyze differences and similarities in maternal contingency scores, the provision of

face-to-face context by caretakers, and the infants' gazing at their mothers and alertness across sociocultural contexts and age, we computed repeated measures analyses of variance (ANOVAs) with age (4, 6, 8, 10, 12 weeks) as the within-subjects factor and cultural group (Münster, Nso) as the between-subjects factor. To analyze the time course of age-related changes, we have reported linear and curvilinear contrasts by age and Age × Cultural Group interactions for each analysis. Significant interactions between age and sociocultural context were clarified by subjecting the age data to separate one-way ANOVAs for each cultural group. Post hoc *t* tests were performed in the case of significant main effects of age. As neither gender nor birth rank (first- vs. later-born) was significant in any of the preliminary analyses, the data were collapsed across these factors for all subsequent analyses. In order to evaluate the stability of contingent responsiveness, the provision of face-to-face context, and indicators of the 2-month shift across ages, we averaged correlations of adjacent time points (Weeks 4 and 6, Weeks 6 and 8, Weeks 8 and 10, and Weeks 10 and 12) separately for each cultural group. To compute averaged correlations, Pearson correlations were Fisher *z*-transformed, averaged, and then back-transformed.

In the final sample, the contingency data of 15 observations (5.7% of the sample) from 12 dyads (4 from Münster) were substituted by the values for adjacent time points of those dyads (van der Kloot, 1998). There were two reasons for substituting data. First, for 5 of the 44 families (3 from Münster) only four of the five observations took place. All of the other families were visited five times as planned. Second, some observations ($N = 10$; 1 from Münster) were excluded because there were only a few NDVs. Therefore, we used an inclusion criterion of at least three NDVs. Missing values of face-to-face ($N = 5$), mutual gaze ($N = 5$), and mutual gaze_{fav} ($N = 27$) were substituted according to the same logic. There were 22 observations (10%) for which mutual gaze_{fav} could not be computed because there was no favorable context which would be tantamount to a division by zero. To test the robustness of the results, all analyses were additionally conducted on the unsubstituted data, and a data set where missing values were substituted by the individual mothers' mean score. The pattern of significant effects and the magnitudes of the effects were identical across all three analyses. It should be noted here that, compared to the ANOVAs, in all of the correlational analyses that follow, only the data gathered during actual observations, that is, unsubstituted data, were analyzed.

Overall Levels and Patterns of Contingent Responsiveness

On average, mothers responded contingently by addressing at least one of the infant's senses to about 57.5% of all NDVs; this figure did not differ between cultural groups or age groups, largest $F(1, 42) = 2.76$, $p > .10$. There was a marginally significant linear contrast for the interaction between cultural group and age, indicating that there were differences in the linear development of overall contingency across age between the cultural groups, $F(1, 42) = 3.62$, $p < .10$, $\eta_p^2 = .08$. Looking at the two cultural groups separately, separate one-way ANOVAs yielded a marginally significant main effect of age on overall contingency for the Münster sample, $F(4, 76) = 2.42$, $p < .10$, $\eta_p^2 = .11$, but no systematic change with age. For the Nso sample, there was no main effect of age on overall contingency, $F(4, 92) = 1.35$, $p > .10$, $\eta_p^2 = .06$, and a marginally significant linear decrease with age, $F(1, 23) = 3.09$, $p < .10$, $\eta_p^2 = .12$ (see Table 1).

The scores for auditory, proximal, and visual contingencies were subjected to separate mixed ANOVAs. On average, 47.2% of the mother's contingent responses to the infant's NDVs were auditory, 43.8% were proximal, and 9% were visual. Auditory and proximal contingencies were independent of cultural context and infants' age, largest $F(1, 42) = 1.28$, $p > .10$. The marginally significant linear contrast of the interaction indicated that there were differences in the linear development of the proximal contingencies with age, $F(1, 42) = 2.85$, $p < .10$, $\eta_p^2 = .06$. Looking at the two cultural groups separately, one-way (age) ANOVAs yielded a significant main effect of age on proximal contingencies for the Münster sample, $F(4, 76) = 2.63$, $p < .05$, $\eta_p^2 = .12$, that could best be explained by a linear decrease with age, $F(1, 19) = 7.15$, $p < .05$, $\eta_p^2 = .27$. There were neither differences nor any systematic changes with age in the Nso sample (see Table 1). Post hoc *t* tests indicate that Nso infants experienced significantly more proximal contingencies than did infants from Münster in Week 12, $t(42) = -2.56$, $p = .014$, $d = -0.77$.

The largest differences pertained to visual contingencies. Infants from the Münster sample experienced more visual contingencies ($M = 13.00\%$, $SE = 1.87\%$) than did infants from the Nso sample ($M = 5.80\%$, $SE = 1.71\%$), $F(1, 42) = 8.07$, $p < .001$, $\eta_p^2 = .16$. On average, these visual contingencies

Table 1
Contingency Levels (Percentage) Across Time and Cultural Context

	Week 4	Week 6	Week 8	Week 10	Week 12
Overall					
Münster	62.56 (19.06)	52.79 (17.04)	64.32 (15.15)	62.57 (13.18)	62.45 (16.56)
Nso	58.33 (17.97)	55.06 (16.67)	56.85 (14.82)	52.73 (19.57)	50.17 (21.74)
Auditory					
Münster	48.56 (16.17)	41.20 (20.32)	45.96 (11.63)	42.66 (9.48)	49.50 (13.73)
Nso	48.85 (16.67)	45.38 (19.51)	51.36 (15.91)	51.41 (25.49)	45.41 (18.34)
Proximal					
Münster	43.80 (17.85)	48.83 (21.54)	41.24 (18.89)	40.45 (22.88)	32.80 (14.01)
Nso	45.55 (18.60)	47.12 (20.76)	44.90 (16.76)	43.53 (26.11)	47.50 (22.27)
Visual					
Münster	7.64 (8.88)	9.97 (13.84)	12.80 (14.27)	16.88 (17.04)	17.70 (13.52)
Nso	5.60 (8.46)	7.50 (8.88)	3.74 (7.67)	5.06 (7.49)	7.09 (12.28)

Note. Values are *M* (*SD*). $N = 20$ for the Münster and $N = 24$ for the Nso sample. Scores are either percentage of nondistress vocalizations (overall contingency level) or percentage of mothers' contingent responses (auditory, proximal, and visual contingency). Auditory, proximal, and visual contingencies add up to 100%.

increased with age, $F(4, 168) = 2.98$, $p < .05$, $\eta_p^2 = .07$. There was, however, a significant interaction, indicating that visual contingencies changed differently with age for the two cultural groups, $F(4, 168) = 3.04$, $p < .05$, $\eta_p^2 = .07$. Looking at the two cultural groups separately, one-way ANOVAs yielded a significant main effect of age for the Münster sample, $F(4, 76) = 3.08$, $p < .05$, $\eta_p^2 = .14$, that could best be explained by a linear increase with age, $F(1, 19) = 11.96$, $p < .01$, $\eta_p^2 = .39$. In contrast, there were neither differences nor any systematic changes with age for the Nso sample. Post hoc *t* tests yielded significant differences between the two cultural groups from Week 8 onward, $t_{\text{week 8}}(42) = 2.55$, $p < .017$, $d = 0.77$; $t_{\text{week 10}}(42) = 2.88$, $p < .01$, $d = 0.87$; and $t_{\text{week 12}}(42) = 2.73$, $p < .01$, $d = 0.83$.

Figure 1 displays the developmental course of the three types of mothers' contingent responsiveness and the emergence of culture-specific contingency patterns in the 3rd month. Intraindividual stabilities were moderate for the total contingency score ($r_{\text{Münster}} = .36$, $p > .10$, $r_{\text{Nso}} = .54$, $p < .05$) and visual contingencies ($r_{\text{Münster}} = .45$, $p < .10$, $r_{\text{Nso}} = .51$, $p < .05$), and mixed for auditory ($r_{\text{Münster}} = .45$, $p < .10$, $r_{\text{Nso}} = -.07$, $p > .10$) and proximal ($r_{\text{Münster}} = .37$, $r_{\text{Nso}} = .16$, both *p*s > .10) contingencies.

Provision of Face-to-Face Context and the 2-Month Shift

The percentage of 10-s intervals in which mothers established face-to-face context was subjected to a 2 (cultural group; between-subjects) × 5 (age; within-subjects) ANOVA. The mothers from the

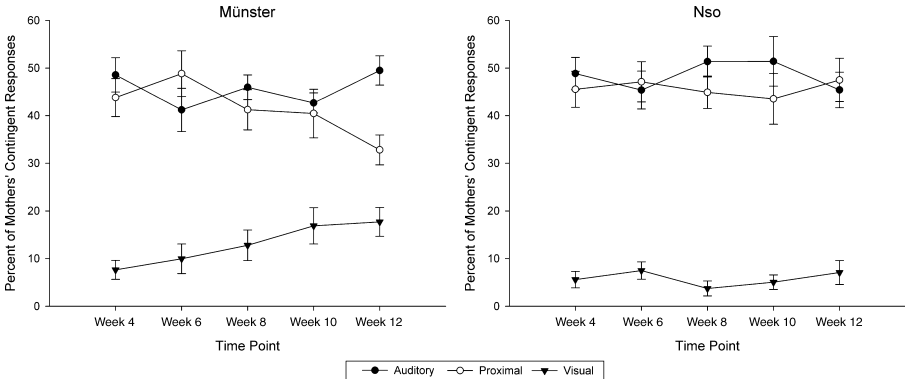

Figure 1. The developmental course of mothers' auditory, proximal, and visual contingencies for Münster and Nso infants.

Münster sample established face-to-face context significantly more often ($M = 0.82$, $SE = 0.05$), than did Nso mothers ($M = 0.49$, $SE = 0.04$), $F(1, 42) = 27.89$, $p < .01$, $\eta_p^2 = .40$. As indicated by the significant interaction, this difference increased with age, $F(4, 168) = 6.01$, $p < .01$, $\eta_p^2 = .13$ (see Table 2). Post hoc t tests indicate that mothers from Münster established face-to-face context for a significantly higher proportion of 10-s intervals than did Nso mothers in all weeks, $t_{\text{week } 4}(42) = 2.87$, $p < .01$, $d = 0.87$; $t_{\text{week } 6}(42) = 2.51$, $p = .016$, $d = 0.76$; $t_{\text{week } 8}(42) = 4.20$, $p < .001$, $d = 1.32$; $t_{\text{week } 10}(42) = 4.24$, $p < .001$, $d = 1.28$; and $t_{\text{week } 12}(42) = 8.58$, $p < .001$, $d = 2.78$.

Looking at the two cultural groups separately, one-way ANOVAs yielded a significant main effect of age for the Münster sample, $F(4, 76) = 3.24$, $p < .05$, $\eta_p^2 = .15$, that could best be explained by a linear increase, $F(1, 19) = 7.81$, $p < .05$, $\eta_p^2 = .29$. The significant main effect of age for the Nso sample, $F(4, 92) = 3.72$, $p < .01$, $\eta_p^2 = .14$, on the other hand, could best be explained by an inverted U-shaped function, $F(1, 23) = 8.64$, $p < .01$, $\eta_p^2 = .27$.

With respect to infants' alertness, there was a significant main effect of age, $F(4, 168) = 17.62$, $p < .01$, $\eta_p^2 = .30$. As indicated by the pairwise comparisons of estimated marginal means, there was a sharp increase in alertness between Weeks 6 and 8 for both sociocultural contexts; the respective mean differences for pairwise comparisons with Bonferroni adjustment ranged from −.18 to −.34, all ps < .01 (see Table 2).

The infants' gazing at their mothers' faces also differed between the cultural contexts and with age. During the episodes when mothers established face-to-face context (mutual gaze_{fav}), infants from the Münster sample looked at their mother faces, thus establishing eye contact, twice as long ($M = 0.36$, $SE = 0.04$) as did infants from the Nso sample ($M = 0.18$, $SE = 0.03$), $F(1, 42) = 14.57$, $p < .01$, $\eta_p^2 = .26$. There was a significant Cultural Context × Age interaction, $F(4, 168) = 4.21$, $p < .01$, $\eta_p^2 = .09$. Inspection of means (see Table 2) indicates that the difference between the cultural samples increased with age. Post hoc t tests yielded significant differences between the two cultural groups from Week 8 onward, $t_{\text{week } 8}(42) = 5.62$, $p < .001$, $d = 1.70$; $t_{\text{week } 10}(42) = 2.55$, $p = .015$, $d = 0.77$; and $t_{\text{week } 12}(42) = 3.06$, $p < .01$, $d = 0.93$.

The analysis of the duration of mutual gaze relative to the duration of the total interaction time (*mutual gaze*) yielded significant main effects for cultural group (Münster: $M = 0.28$, $SE = 0.03$; Nso: $M = 0.08$, $SE = 0.03$), $F(1, 42) = 24.50$, $p < .01$, $\eta_p^2 = .37$, as well as age, $F(4, 168) = 4.72$, $p < .01$, $\eta_p^2 = .10$. Furthermore, there was a significant Cultural Context × Age interaction, $F(4, 168) = 5.88$, $p < .01$, $\eta_p^2 = .12$. Looking at the two cultural groups separately, one-way ANOVAs yielded a significant main effect of age only for the Münster sample, $F(4, 76) = 5.67$, $p < .01$, $\eta_p^2 = .23$, that could best be explained by a sharp increase in mutual gaze between Weeks 6 and 8. Respective mean differences for pairwise comparisons with Bonferroni adjustment ranged between −.18 and −.23, all

Table 2
Face-to-Face Context, Alertness, and Mutual Gaze (Proportions) Across Time and Cultural Context

	Week 4	Week 6	Week 8	Week 10	Week 12
Face-to-face					
Münster	0.75 (0.26)	0.78 (0.27)	0.81 (0.20)	0.84 (0.23)	0.92 (0.10)
Nso	0.50 (0.31)	0.56 (0.30)	0.47 (0.32)	0.53 (0.25)	0.37 (0.27)
Alertness					
Münster	0.70 (0.30)	0.62 (0.35)	0.92 (0.16)	0.96 (0.12)	0.98 (0.04)
Nso	0.79 (0.35)	0.71 (0.41)	0.94 (0.20)	0.96 (0.10)	0.99 (0.02)
Mutual gaze_{fav}					
Münster	0.28 (0.26)	0.29 (0.25)	0.48 (0.26)	0.40 (0.33)	0.38 (0.25)
Nso	0.22 (0.22)	0.23 (0.29)	0.11 (0.15)	0.18 (0.23)	0.16 (0.22)
Mutual gaze					
Münster	0.16 (0.19)	0.16 (0.19)	0.39 (0.28)	0.36 (0.31)	0.35 (0.24)
Nso	0.09 (0.13)	0.09 (0.16)	0.06 (0.09)	0.10 (0.19)	0.08 (0.16)

Note. Values are M (SD). Scores are relative frequencies of 10-s intervals (face-to-face and alertness) or relative durations (mutual gaze and mutual gaze_{fav}). Mutual gaze_{fav} indicates the duration of mutual gaze relative to the duration of episodes in which mothers established face-to-face context and infants were alert. Mutual gaze indicates the duration of mutual gaze relative to the duration of the entire episode. $N = 20$ for the Münster sample and $N = 24$ for the Nso sample.

ps < .05 (see Table 2). Post hoc t tests indicate that, from Week 8 on, dyads from the Münster sample established mutual gaze longer than did dyads from the Nso sample, $t_{\text{week 8}}(42) = 5.18$, $p < .001$, $d = 1.57$; $t_{\text{week 10}}(42) = 3.22$, $p < .01$, $d = 0.97$; and $t_{\text{week 12}}(42) = 4.16$, $p < .001$, $d = 1.26$.

Intraindividual stabilities were reasonably high for the face-to-face context, $r_{\text{Münster}} = .49$, $r_{\text{Nso}} = .64$, both ps < .05, rather low for alertness, $r_{\text{Münster}} = .35$, $r_{\text{Nso}} = .17$, both ps > .10, and moderate for mutual gaze, $r_{\text{Münster}} = .33$, $p > .10$, $r_{\text{Nso}} = .45$, $p < .10$.

Contingency Patterns, Face-to-Face Context, and the 2-Month Shift

So far, the results indicate that changes in visual contingency parallel changes in the extent of face-to-face context provided by caretakers as well as changes in mutual gaze scores. For all of these scores, there was a significant increase across age for the Münster but not for the Nso sample. Within both cultural groups, averaged correlations between the two mutual gaze scores and visual contingency were significant, mutual gaze: $r = .50$, $p < .05$ for Münster and $r = .71$, $p < .01$ for Nso mothers, and mutual gaze_{fav}: $r = .41$, $p_{\text{one-sided}} < .10$ for Münster and $r = .64$, $p < .01$ for Nso mothers, supporting the assumption that on the dyad level, a longer duration of mutual gaze and mutual gaze_{fav} was associated with a higher proportion of visual contingencies. Since, first, the two mutual gaze scores were highly correlated, $r = .95$ for the Münster sample and $r = .91$ for the Nso sample, ps < .001, and, second, there were less missing values for mutual gaze, we focused on mutual gaze in the following analyses.

For both mutual gaze and visual contingency, there were large differences between the two cultural groups from Week 8 onward. These data raise the question of whether the between-culture differences in mutual gaze and visual contingency were independent of each other or whether differences in visual contingency could, at least in part, be explained by differences in mutual gaze. The latter alternative would mean that if mothers and infants were to look at each other, mothers in both sociocultural contexts would behave similarly in terms of visual contingency. To address this issue, we computed two-step analyses separately for Weeks 8, 10, and 12 (van de Vijver & Leung, 1997). First, we computed a one-factorial (culture) ANOVA on visual contingency and, second, we computed a one-factorial (culture) ANCOVA on visual contingency with mutual gaze as the covariate. The change in η_p^2 for culture between the ANOVA and the ANCOVA gives us an indication of the extent to which differences in mutual gaze explain the cross-cultural differences in visual contingency. In all three ANOVAs, η_p^2s indicated large between-culture differences in visual contingency, smallest $F(1, 42) = 7.19$, $p < .05$, $\eta_p^2 > .14$. Entering mutual gaze as a covariate, the main effects of culture were no longer significant for any of the weeks, largest $F(1, 41) = .76$, $p > .10$, $\eta_p^2 < .04$. These findings support the hypothesis that mutual gaze largely explains cross-cultural differences in visual contingency.

These results indicate that during mutual gaze-episodes Nso mothers were as visually contingent as their Münster counterparts. The questions remain, however, as to why the Nso dyads generally engaged less in face-to-face interaction than did the Münster dyads and why the 2-month shift followed a different pattern (increase in awake alertness but not mutual gaze) in the Nso sample compared to the Münster sample. In order to address these questions, we conducted exploratory analyses of the intercorrelations between face-to-face context, mutual gaze, visual contingencies, and sociodemographic variables (e.g., mothers' education and age) that might help to explain intracultural variation. Of the sociodemographic variables that we analyzed, maternal education was the most relevant. We used a dichotomous score that differentiated between mothers who had received 7 years of formal schooling ($N = 17$) and mothers who had spent more time in school (either 9 [$N = 1$] or 12 [$N = 4$] years). Even though only five mothers had received a higher degree of formal education, averaged point-biserial correlations between education and all other scores were consistently positive, though not significant: $r = .25$ with face-to-face context, $r = .20$ with mutual gaze, and $r = .31$ with visual contingency. The correlations were highest between education and face-to-face context at 12 weeks, $r = .48$, $p < .05$; between education and mutual gaze at 4 weeks, $r = .50$, $p < .05$; and between education and visual contingency, $r_{\text{week 4}} = .42$, $p < .10$; $r_{\text{week 10}} = .47$, $p < .05$; $r_{\text{week 12}} = .42$, $p < .10$. There were no systematic relations between education and either proximal, $r = -.26$ to $-.08$, $p > .10$ or auditory, $r = -.10$ to .05, $p > .10$, contingency scores.

Discussion

The purpose of this study was to analyze in detail how culture-specific contingency patterns develop

during the first months of life. To address this issue, we explored how mothers' contingency patterns changed during the infants' 2nd and 3rd months of life and analyzed to what degree this development was influenced by sociocultural or other contextual factors.

As we hypothesized, there were no significant differences in the overall contingency level between cultural groups or with the infants' age. Mothers responded contingently to about 60% of their infants' NDVs. This result is very similar to Kärtner et al.'s (2008) finding of an overall contingency rate of 63% across six different sociocultural contexts. It seems, therefore, that contingent responsiveness is a universal component of intuitive parenting.

Also consistent with previous research is the finding that after 2–3 months of age, there were similarities as well as differences in the contingency patterns between the two cultural groups. Generally, mothers from both sociocultural contexts gave auditory responses far more often than they gave visual responses. Furthermore, in both samples there was no change in auditory contingencies with age. Other forms of maternal responsiveness, however, did vary across cultural contexts. As indicated by the proportional scores for auditory, proximal, and visual contingencies, 8- to 12-week-olds from the Münster sample experienced significantly more visual contingencies than did Nso infants and 12-week-olds from the Münster sample experienced significantly less proximal contingencies than did Nso infants. Within cultural contexts, 12-week-olds from the Münster sample experienced auditory contingencies more often than they did proximal contingencies, followed by visual contingencies. Twelve-week-olds from the Nso sample, in contrast, experienced proximal contingencies as often as they did auditory contingencies.

Interestingly, the modal differences in contingency patterns were not present at 4 weeks but emerged during the infants' 2nd and 3rd months. For the Münster sample, there was a linear increase in visual contingencies and a linear decrease in proximal contingencies. For the Nso sample, all contingency scores were continuous across the infants' age. Thus, these results clearly indicate differential developmental trajectories within the two sociocultural contexts.

In order to better understand this differential development, we analyzed the degree to which developmental processes were influenced by other factors, such as the provision of face-to-face context by caretakers and the infants' awake alertness and gazing pattern as indicators of the 2-month shift. As expected, mothers from the Münster sample established face-to-face context longer than did Nso mothers and this difference between the two cultural contexts increased with age. With respect to the 2-month shift, the infants' alertness increased sharply from Weeks 6 to 8 in both sociocultural contexts and reached about 100% in the 12th week.

The infants' gazing patterns are another indicator of the 2-month shift. In this respect, infants from the Münster and Nso samples were quite different. For the Münster infants, there was an age-dependent increase in the percentage of time that the infants looked back at their mothers while their mothers established face-to-face context (mutual $gaze_{fav}$). For the Nso infants, however, there was no change in the percentage of time that the infants looked back at their mothers. The difference in looking patterns with age between the two samples gave rise to significant differences between the samples from Weeks 8 to 12. As a consequence, the duration of mutual gaze relative to the total interaction time, a factor influenced by both the provision of face-to-face context and the infants' interest, exhibits an abrupt increase between Weeks 6 and 8 in the Münster sample but not in the Nso sample. This sharp increase in the duration of mutual gaze together with the sharp increase in alertness in the Münster sample can be taken as evidence of the 2-month shift as it is usually described in the literature (Lavelli & Fogel, 2002, 2005).

The results paint a different picture for the Nso infants since the 2-month shift seems to take a different shape: The Nso infants exhibited a similar sharp increase in awake alertness with age to the Münster infants, but the Nso infants' interest in their mothers' faces, that is, their gazing behavior, did not change with age. Across the 12 weeks, the relative duration of both face-to-face context established by the mothers and the two mutual gaze scores were continuous. Furthermore, interdyad differences remained relatively stable in the Nso context, and intercorrelations between face-to-face context, mutual gaze, and visual contingency were quite high for the Nso sample. These findings support the interpretation that each Nso mother provided a certain extent of face-to-face context and visual contingency that did not change much as the infant grew older.

In interpreting this cross-cultural developmental divergence, one has to keep in mind that most of the studies on the 2-month shift are monocultural studies from predominantly Western contexts (Emde, 1984; Lavelli & Fogel, 2002; Stern, 1985; Wolff, 1987). As indicated by the results, there was

no difference in visual contingent responsiveness between the mothers from the two sociocultural contexts, per se. What differed between the two cultural contexts were the age-related changes in the provision of face-to-face context as well as the duration of mutual gaze itself. What are the possible reasons for these developmental differences in face-to-face context established by mothers and the infants' gazing behavior?

From a sociocultural perspective, we argue that caretakers hold culture-specific beliefs about parenting and follow different parenting strategies and behavioral scripts while interacting with their infants. These parenting beliefs and strategies lead to different developmental outcomes, which have an adaptive value within the specific sociocultural context. With respect to face-to-face context, there are several studies that have shown that face-to-face context and exclusive dyadic interaction play a central role in prototypically independent sociocultural contexts (Brazelton, 1977; Keller, 2007; Whiting & Pope Edwards, 1988). Furthermore, there is empirical evidence that distal parenting characterized by face-to-face interaction and object stimulation fosters the development of an autonomous self, which is one of the central developmental outcomes emphasized in independent sociocultural contexts (Keller, Kärtner, et al., 2005; Keller, Yovsi, et al., 2004). Nso mothers' parenting, in contrast, can best be described as proximal parenting with its emphasis on body contact and body stimulation (cf. Keller, 2007). According to Nso ethnotheories, these parenting strategies instill a sense of community that is characterized by obedience, deference, collective responsibility, and sharing (Goheen, 1996; Nsamenang & Lamb, 1994). Furthermore, there is empirical evidence that body contact and interactional warmth support the development of acceptance of the families' norms and values and compliance (Keller, Yovsi, et al., 2004; MacDonald, 1992).

It is important to keep in mind that, generally, infant communicative signals and mothers' behavior cannot be interpreted in isolation. Mother–infant interaction is a bidirectional process in which each partner's behavior is reciprocally influenced by the behavior of the other. Thus, the differences in the duration of gazing at the mothers' faces (mutual $gaze_{fav}$) found in this study cannot be attributed to the infants alone, even though we have described the infants' gazing as their *interest* in their mothers' faces. Rather, culture-specific scripts and behavioral standards of the mothers may have interacted with emerging behavioral potentials. Thus, in sociocultural contexts that favor face-to-face communication, mothers may enthusiastically promote mutual gaze and face-to-face interaction with their infants. Lavelli and Fogel (2005) identified positive feedback and mutual amplification as mechanisms that contribute to the consolidation of emerging behavioral patterns. In light of their results, the finding that the duration of time that the Münster infants looked at their mothers' faces while their mothers provided face-to-face context (mutual $gaze_{fav}$) increased parallel with an increase in the mothers' provision of face-to-face context may exemplify the consolidation of such an emerging behavioral pattern. For example, the more the mother establishes face-to-face context, the more probable it is that the infant will engage in mutual gaze if he or she is looking at his or her mother, which may be rewarding because of the stimulation that mothers provide during face-to-face interaction. For mothers, in turn, these experiences are rewarding because of their ethnotheoretical underpinning that mutual gaze and face-to-face interaction is a desirable way of interacting with infants. If this ethnotheoretical underpinning is missing or different, as in the Nso sample, stable and continuous development should be the consequence.

But what implications might the different ethnotheoretical underpinning of Nso mothers' caretaking have for the dynamics of mother–infant interaction? Generally, Nso mothers treat their infants as novices who need to learn compliance and subordination from early on (Nsamenang, 1992). In a qualitative analysis of the Week 12 interactions from the present study, Demuth (2008) described the prototypical Nso mother–infant interaction as characterized by rhythmic-synchronous structuring and both normative-hierarchical and socially oriented discourse. In contrast to the turn-taking sequences typical of mother–infant interaction in Münster, the Nso interactions include a large amount of repetitions and nonverbal vocalizations, which may lead to a symbiotic relationship stressing the unity between mother and infant. Repetitive patterns in Nso mother–infant interaction typically comprise musical chorusing as well as repeated addressing or greeting of the infant. These utterances were often synchronized with rhythmic body stimulation, for example, mothers rhythmically bouncing their infants. If one thinks in terms of consolidating behavioral patterns that are typical for interdependent sociocultural contexts, one may need to look beyond face-to-face interaction and toward developmental domains like affect regulation and calmness as an early precursor of

proper demeanor and obedience (LeVine, 1994). However, the results of these studies point to the direction that, generally, Nso mothers take the lead and structure the interaction; that is, Nso parenting is more directive and is mother directed rather than child focused.

In the final step of our analyses, we explored to what extent other contextual factors (e.g., education) influenced the contingency patterns and dynamics of face-to-face interaction within the Nso sample. What we found was that the mothers' level of formal education (7 vs. 9 or more years) was associated with the provision of face-to-face context, the extent of mutual gaze, and the level of visual contingency. In a study on the effect of school attainment on mothers' contingent responsiveness, Richman et al. (1992) showed comparable results to ours. The higher the Mexican mothers' level of formal education (between 1 and 9 years), the more they talked and looked in response to vocalizations of their 10- or 15-month-olds. On the basis of these findings alone, it is unclear exactly how schooling affects maternal responsiveness. It seems, however, that schooling may provide women with experiences and models of social interaction that they would not acquire without schooling. These experiences may, in turn, influence the way in which they later interact with their infants. This interpretation is further supported by studies that have shown that education, with the accompanying changes in income and living standards, reorients socialization goals and parenting ethnotheories toward autonomy and independence (Laosa, 1982; LeVine, Miller, Richman, & LeVine, 1996). With regard to the Nso culture, Yovsi and Keller (2007) have shown that maternal school attainment is associated with changes in sleeping arrangements (shift from mother–infant to husband–wife cosleeping) and planned weaning date. Thus, there is evidence that formal education drives cultural change through its impact on ethnotheories, socialization goals, and norms of social interaction.

While the present study has a number of strengths in that it provided new evidence for intercultural similarities and differences in contingent responsiveness and the 2-month shift, it also has some limitations. First, due to the time-intensive coding of repeated observations, the sample sizes were relatively small. Furthermore, we substituted missing values in order to avoid listwise deletion in the repeated measures analyses. The robustness of the present findings, however, was supported by the fact that the pattern of significant results was identical regardless of whether missing values were substituted by mean scores, by adjacent values, or deleted listwise. Second, observations came from contexts that are prototypical for an independent and an interdependent sociocultural orientation: highly educated middle-class families in Münster and rural Nso farmers with only basic formal education living in a subsistence-based ecology. Based on our sociocultural approach, we argue that one has to be cautious about generalizing these data beyond the specific sociocultural contexts described. The contingency patterns that we found certainly do not apply to the country level. In order to determine whether generalizing these data to similar sociocultural contexts in the same or in other countries is appropriate, the results found here need to be replicated by further research with other prototypically independent or interdependent contexts. Last, there is evidence that Nso mothers focus more on proximal parenting; in Nso mothers' ethnotheories, mother–infant attachment is mainly defined in terms of bodily closeness, and body contact plays an important role in sensitive parenting (Otto, 2008; Yovsi, Kärtner, Keller, & Lohaus, 2009). By focusing on NDVs we tried to give justice to culture-specific emphases on face-to-face context and body contact. It is possible, however, that there are alternative mechanisms or communication systems that drive developmental change in early mother-infant communication in a way that is more typical for the Nso context.

In the present study, we could demonstrate that culture-specific contingency patterns in mother–infant interaction emerge during the 2nd and 3rd months of life. This differential development is associated with culture-specific differences in the duration of mutual gaze during social interaction, which indicates the effectiveness of broader cultural models, in this case, the prominence of face-to-face exchange in social interaction.

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