

Parenting styles and the development of the categorical self: A longitudinal study on mirror self-recognition in Cameroonian Nso and German families

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This prospective study contributes to the understanding of the development of self-conceptions in cultural context. We examined the influence of maternal contingent responsiveness towards their 3-month-old infants on toddlers' self-recognition at the age of 18 to 20 months. We contrasted two samples that can be expected to differ with respect to contingent responsiveness as a parenting style: German middle-class families and Cameroonian Nso farmers. As hypothesized, German mothers reacted more contingently than Nso mothers. Furthermore, German toddlers recognized themselves more often than Nso toddlers. Finally, we found that the level of contingent responsiveness was one of the mechanisms that accounted for mirror self-recognition. The results are discussed with respect to different cultural emphases on parenting strategies.

Introduction

The present study is aimed at contributing to the developing field of culturally informed pathways of self-development (Greenfield, Keller, Fuligni, & Maynard, 2003; Keller & Greenfield, 2000). We assess the contingency experience of 3-month-old infants in two environments with different socio-cultural orientations, and link the contingency experiences to the development of self-recognition. We contrast German urban middle-class families from the capital of Berlin with rural Nso farmer families. It is assumed that German middle-class families support independent socialization goals as expressed in a distal parenting style of eye-to-eye contact and object stimulation; Cameroonian Nso farmer families are supposed to support interdependent socialization goals as expressed in a proximal parenting style of body contact and body stimulation (Keller, 2003; Keller et al., in press a, 2004a, 2004b; Keller, Schölmerich, & Eibl-Eibesfeldt, 1988; Keller, Voelker, & Yovsi, in press b; Keller, Yovsi, & Voelker, 2002; Yovsi & Keller, 2003).

The experience of contingent responsiveness

The first developmental task of self-development entails the differentiation of the self from the external environment. Based on perceptual sensitivity, an existential (Lewis & Brooks-Gunn, 1979) and perceptual self (Neisser, 1993) emerges during the early months of life and is apparent at the age of about 3 months. Contingency detection represents one of the major inborn developmental mechanisms (Watson, 1985) that support the development of an existential self (Keller, 2003). Contingency refers to the temporal relation between two events that potentially reflects a causal dependency. There are

two possible ways to analyse contingent parental behaviour: dependency refers to the extent to which parental behaviour is elicited by infant signals, whereas responsiveness refers to the relative probability that an infant signal is followed by contingent parental behaviour (Watson, 1985). Until about 3 months, infants seek the highest level of contingency that they can detect (Watson, 1985). Therefore infants' stance towards people is attentional (Rochat & Striano, 1999).

The provision of contingent responses to infant signals is part of the intuitive parenting repertoire (Keller, Lohaus, Voelker, Cappenberg, & Chasiotis, 1999; Keller et al., 1988; Papoušek & Papoušek, 1991). Accordingly, contingency games like imitation and circular reactions in the facial and vocal modalities are characteristic of caregiver-child interactions during the first months of life (Lewis & Brooks-Gunn, 1979). Caregivers respond within a time range of about 1 second to infants' facial and vocal cues (Keller, Chasiotis, & Runde, 1992; Keller et al., 1999; Papoušek & Papoušek, 1991). Thus, intuitively they match the memory span of the small infant. This pattern allows the infant to perceive the caregiver's behaviour as a consequence of their own signals (Cohn & Tronick, 1988; Fogel, 1993; Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001; Kaye & Fogel, 1980; Keller et al., 1999; Lavelli & Fogel, 2002). The development of an existential self is thus based on a "contemplative stance" (Rochat & Striano, 1999) that emerges around 2 months of age. At this age, infants start to demonstrate an emerging capacity to explore the consequences that their own actions have on their social partners.

However, infants are not the passive recipients of contingencies provided by their social partners. They act on social as well as nonsocial objects in the world in order to relate the consequences to their actions (Bertenthal, 1996). They see their actions reflected in others (Bigelow, 1998), and learn that

behaviour has effects (Lewis & Goldberg, 1969). Therefore, the experience of their own agency is one of the principal factors for the infants' development in terms of the differentiation from the environment and a generalized sense of self as an effective agent (Skinner, 1985). Accordingly, contingency experiences have been related to the development of beliefs about personal effectiveness, control (Skinner, 1985), and the predictability of the behaviour of others (Lamb, 1979), as well as the development of autonomy and agency (Keller, 2003; Keller et al., 1999). Infants appear to derive gratification and a sense of self-control from observing the results of their own activity and agency (Gibson & Adolph, 1992). Experiencing contingencies is rewarding, since it is accompanied by positive affect (Keller et al., 1999).

Mirror recognition

The expression of the categorical, objective self represents the next integrative developmental task with respect to self-development (Lewis & Brooks-Gunn, 1979). It is commonly acknowledged that the self is reflected in self-referencing behaviour, self-awareness, secondary emotions like pride, guilt, and shame, representational memory, and intersubjectivity. The categorical self is thus based on a mental model of the self. This developmental milestone seems to be achieved at the age of 18 to 20 months (Hart & Fegley, 1994). At about this age, toddlers begin to respond to their mirror image as if they knew that it is themselves (Bischof-Köhler, 1991; Lewis & Brooks-Gunn, 1979; Lewis, Sullivan, Stranger, & Weiss, 1989). The toddlers' self-referential behaviour in front of the mirror after rouge has been put on their faces (the classical rouge test) can be taken as evidence for the acquisition of a conceptual self-knowledge (Amsterdam, 1972; Bischof-Köhler, 1991; Gallup, 1977). The self-knowledge can be assumed to form a categorical self-concept in terms of the awareness that the self is a separate, physical entity and a source of actions, words, ideas, and feelings (Edwards & Liu, 2002). Mirror recognition represents a capacity that is independent of the child's familiarity with reflecting surfaces, as was shown in a field study with Bedouin-nomadic participants from the Negev region (Priel & DeSchonen, 1986; see also Hart & Fegley, 1994; Lewis & Brooks-Gunn, 1979). Applying a longitudinal design with monthly assessments between 14 and 24 months, Hart and Fegley demonstrated that the exposure to the mirror and the rouge test did not lead to earlier self-recognition. The children in this study on average showed mirror recognition at the age of 18;1 months, which is comparable to cross-sectional studies. There is ample evidence that although children are able to produce self-referential behaviour in the rouge test, they do not know many of the properties of reflecting surfaces (Butterworth, 1990). Thus, mirror recognition as a single measure of self-referential behaviour appears to remain the best index of the construct of "me" available (Lewis, 1994), even in cultural environments that differ with respect to the extent to which children are familiar with mirrors.

Cultural styles of parenting and their developmental consequences

The ideas and empirical studies discussed so far are all rooted in developmental conceptions and theories that are based on Western views of the self as independent, i.e., agentic, stable, self-contained, separate, and autonomous (Kağitçibaşı, 1996;

Keller, 2003; Keller et al., 2004a, b). Parenting strategies during the early months of life that support the development of an independent self emphasize processes of facial imitation and contingent reactions to infant signals during face-to-face exchange. These processes further the development of the perception of causality and agency that are central to an independent construal of the self (Greenfield et al., 2003; Keller, 2003; Keller & Greenfield, 2000). This distal style of parenting is prevalent in Western middle-class families (Keller et al., 1988, 1999, 2004a).

Yet there are marked differences with respect to parenting strategies as well as with respect to conceptions of the self in different cultural environments. Rural agrarian farming families in traditional societies, in particular, have been described as valuing an interdependent or sociocentric conception of the self that is basically interrelated with the family; fluid, harmonious, respectful, and heteronymous. Parenting strategies during infancy that support the development of this conception of the self have been described as emphasizing body contact and body stimulation (Keller et al., 2002, 2004a, 2004b, in press b; LeVine et al., 1994; Super, 1976). Face-to-face contact is less prominent and thus the provision of contingent responses in the face-to-face mode is accordingly reduced. In a study linking early parenting experiences to the development of self-recognition and self-regulation in toddlerhood, Keller et al. (2004b) found that toddlers who experienced predominantly mutual eye contact and object stimulation, and thus a distal parenting strategy that can be related to independent socialization goals, showed self-recognition in the mirror recognition task earlier than toddlers who had experienced a proximal parenting style favouring body contact and body stimulation, which can be related to more interdependent socialization goals (Keller et al., 2004a). Therefore we also expected toddlers who have experienced more contingent responsiveness during facial exchanges, like infants in German middle-class families, to recognize themselves earlier than toddlers who have experienced less contingent responsiveness during facial exchanges, like infants in Cameroonian Nso farming families.

Studies with Western middle-class toddlers have demonstrated that mirror recognition is not an on-or-off achievement, but that it develops gradually (Bertenthal & Fischer, 1978). It is possible that toddlers oscillate between different levels of self-recognition during a transitory phase (Bischof-Köhler, 1989). Furthermore, systematic differences in toddlers' interaction behaviour with the mirror depend on their competence in recognizing themselves. Toddlers not yet recognizing themselves show more playmate behaviour, since they more often think of the mirror image as a peer (Bischof-Köhler, 1989), whereas toddlers recognizing themselves show more experimenting behaviour, i.e., testing contingency hypotheses. Moreover, in their longitudinal study Lewis and Brooks-Gunn (1979) found that children who recognize themselves look in the mirror more frequently than children who do not recognize themselves (Bischof-Köhler, 1991; Lewis & Brooks-Gunn, 1979). With the analysis of these additional behaviours we would like to analyse whether the processes of the development of self-recognition hold for different cultural environments.

To summarize, we hypothesized that 3-month-old infants of Cameroonian farmers experience less behavioural contingencies in mother-infant free-play than infants from German middle-class families. Furthermore, we expected that toddlers of 18 to 20 months of age from Cameroonian farmers show

self-recognition less often than German middle-class toddlers. With respect to the interaction behaviour towards the mirror, we hypothesized that toddlers who recognize themselves show more experimenting and less playmate behaviour than toddlers who do not recognize themselves, who are expected to show more playmate behaviour and less experimenting. Furthermore, we expected recognizers to look at their mirror image longer after some rouge has been put on their faces than nonrecognizers. Analysing the samples longitudinally, we expected infants who experienced more contingency at the age of 3 months to be more likely to recognize themselves at the age of 18 to 20 months.

Method

Participants

Seventy-two families from the two cultural communities volunteered to participate in the study. The original German sample consisted of 41 mother–infant dyads, and the Cameroonian sample of 31 dyads.

The recruitment of participants depended on the local customs of the respective cultural community. In the rural Nso community, the subdivisional officer contacted the Fon of Mbiame (sovereign of the region) to inform him about the study and solicit his permission and support. The families were then invited to participate through announcements in the Catholic and Protestant churches, social gatherings, and women's groups. A number of participants were personally contacted by members of the research team and asked to participate. All the families involved consented to participate. For the German sample, research assistants from the University of Osnabrueck collected the data in cooperation with a local hospital in the city of Berlin.

The rural Nso sample was composed of 19 later-born and 12 first-born children. In the first assessment, the mean age of the mothers was 28 years ($M = 27$ years 11 months, $SD = 6$ years 10 months) and the mean age of the fathers was 37 years ($M = 37$ years 1 month, $SD = 8$ years 1 month). Both the groups, mothers ($M = 6$ years 11 months, $SD = 11$ months) and fathers ($M = 6$ years 6 months, $SD = 1$ year), went to school for an average of 7 years.

The urban German sample consisted of 31 first-born and 10 later-born children. In the first assessment, mothers were 34 years old ($M = 33$ years 11 months, $SD = 3$ years 11 months) and fathers 36 ($M = 35$ years 11 months, $SD = 6$ years). Formal education lasted 16 years for mothers ($M = 15$ years 6 months, $SD = 3$ years 2 months) and fathers ($M = 15$ years 8 months, $SD = 3$ years 5 months).

The first assessment took place when the youngest infant in the family was 3 months old. There were no significant age differences between the Nso ($M = 2$ months 26 days, $SD = 7$ days) and the German sample ($M = 3$ months 3 days, $SD = 9$ days). Gender distribution was held equal across samples (Nso: 11 male and 20 female; German: 21 male and 20 female). All children were physically healthy at the time of assessment. For the analysis of mothers' contingent responsiveness towards nonverbal child signals, several dyads had to be excluded: five Cameroonian infants were disturbed or sleepy most of the time; five German infants exceeded the required age range, 3 children were disturbed most of the time, and 7 videotaped situations consisted primarily of primary

care. The final sample was comprised of 26 German and 26 Cameroonian mother–infant dyads.

Not all children who had participated in the first assessment were available for the second assessment, which was scheduled when the infants were between 18 and 20 months old. In the German sample, eight families could not be located for the second assessment. In the Cameroonian sample, two children had died of meningitis, three families had moved far away, and one child was in hospital when the second assessment was scheduled. Five children refused to cooperate in the second assessment. The final sample consisted of 33 German and 20 Cameroonian toddlers. There were no significant age differences between the Nso ($M = 18$ months 29 days, $SD = 1$ month) and the German sample ($M = 19$ months 2 days, $SD = 7$ days).

For the longitudinal analysis, the sample consisted of 23 German and 15 Cameroonian toddlers. The reduction in size did not affect the sociodemographic variables reported above.

Apparatus and procedure

THE 3-MONTHS ASSESSMENT

Local research assistants collected the data in the families' homes between 2000 and 2003. The 3-month visits started with a familiarization phase, followed by the interview assessing demographic information. Thereafter, a free-play situation with the mother and the baby was videotaped. All communication was in the local language, i.e., German in Berlin and Lamnso in the Nso community. Because our intention was to examine a setting in every culture that allows the assessment of similarities as well as differences in parenting, we decided to focus on mother–infant free-play situations. Free-play situations required the infant to be awake and fed, but there were no further specifications with respect to content or duration. Although German middle-class families and Cameroonian farmers differ substantially in their definitions of the adequate care of small babies (Keller et al., 2002, 2004a, in press b; Yovsi & Keller, 2003), they both have a conception of playing with a baby (Lamnso: "seeri"; German: "sich mit einem Baby beschaefigen").

In order to familiarize the families with the videotaping procedure, we recorded care-taking and other routine situations prior to the actual recording of the mother–infant free-play interaction. The mean length of the videotaped free-play sequences was 9 min 51 s ($SD = 1$ min 13 s) for the Cameroonian sample and 9 min 58 s ($SD = 1$ min 5 s) for the German sample. All participants received a small gift as an acknowledgement of their participation.

Contingency to infant signals during positive infant states. Two members of the German coordination centre did the contingency analyses of the videotaped free-play interactions using a computer-based coding system (Voelker et al., 1999). Using a time sampling method based on 10-second intervals, the infant's state (awake or sleepy) and mood (negative or neutral/positive) was coded. Furthermore, the intervals were coded as favourable for face-to-face contact when it was possible for the infant to engage easily in mutual eye contact for at least half of the interval. If the mother or the infant could not be clearly seen on the video, these events were coded as not visible and excluded from the further analyses. We reduced the analysis of contingency to those sections of the videotaped interaction

episodes where the following three requirements were met: the mother establishes a face-to-face context, the child is awake, and the child is in a neutral or positive state.

The analysis was restricted to nonverbal contingencies since they produced closer longitudinal relations in previous studies (Keller, Voelker, & Chasiotis, 1993; Keller, Voelker, & Wessing, 1996; Voelker et al., 1999). The occurrence of discrete nonverbal behavioural events during these intervals was coded with a microanalytical event-sampling technique. The behavioural categories for the infants were the onset of looking at the mother's face and the onset of smiling. The behavioural categories for mothers were the onset of looking at the infant's face, the onset of smiling, and the onset of expressive eyebrow and mouth movements. We first assessed the behavioural events of the mother and then, in a second run, those of the infant. If a child event is followed by a maternal behaviour within the latency window of 1 second, this behaviour is coded as a contingent response (Keller et al., 1999). The agreement of the observers was tested by a standard set of five mother-infant interactions with durations between 420 and 1030 seconds. Because Cohen's Kappa cannot be calculated for distinct temporal events, a proportion-index of inter-rater agreement was calculated by dividing the number of observed agreements by the number of observed agreements plus the number of both coders' observed disagreements. Because it was not expected that the face-to-face system occurred in every dyad of this study, two different indices comparing contingency experiences of the infants in the two cultural communities were defined. The first was the *relative frequency of latencies*. It indicates the average number of contingent experiences a baby had on the average per minute. As a second measure, *Watson's responsiveness index* (Watson, 1979, 1985) was calculated. This index is the conditional probability that a behavioural event of the mother follows a behavioural event of the infant within a given latency window. This conditional probability is corrected by the unconditional probability of a maternal behavioural event during the total interaction interval. The resulting index expresses the corrected proportion of infant's events that lead to maternal responses within a specific latency window. The inter-rater reliability for the two coders was .76 for the identified latencies.

The assessment of self-recognition

When the children were about 18 to 20 months old, two local researchers visited the families at home. Each visit started with a familiarization phase followed by the rouge test, the standard procedure for the assessment of self-recognition (Amsterdam, 1972; Bischof-Koehler, 1989; Gallup, 1977).

Rouge test. We used a mirror in which the child could at least see his or her upper trunk and face. In the beginning, the child was confronted with the mirror without being marked. After approximately 2 minutes, the mother, pretending to blow the child's nose, put some red colour (lighter red in Cameroon and darker red in Germany) on the child's cheek close to the nose. With this mark on the face the child was confronted with the mirror again. The first and the second mirror confrontation were videotaped. The mean recorded time of the first mirror confrontation was 50 s ($SD = 24$ s), 47 s ($SD = 28$ s) for the Cameroonian sample, and 52 s ($SD = 21$ s) for the German sample. The recorded time of the second mirror confrontation was 71 s ($SD = 47$ s), 59 s ($SD = 22$ s) for the Cameroonian

sample, and 79 s ($SD = 56$ s) for the German sample. There were no significant differences concerning the recorded time between both samples.

Bischof-Koehler (1989) identifies and defines two categories to describe the behaviour that a child shows when looking in the mirror with the colour mark on the face: "recognizer" (the child points at the mark on his or her face or tries to clean his/her cheek and/or the child says his/her name while looking in mirror) and "nonrecognizer" (the child does not point at the mark on his or her face and does not try to clean his/her cheek and the child does not say his/her name when looking in mirror).

Along with the coding of this dichotomous category, different behavioural reactions of the child were coded for the whole exposition time. Concerning the toddlers' interaction behaviour, we concentrated on experimenting and playmate behaviour. Experimenting was coded when the child's behaviour referred to him or herself (e.g., the child moves body parts in front of the mirror while observing the movements in the mirror) and playmate was coded when the interaction with the mirror was of a social character (e.g., the child tries to give toys to the mirror image and looks behind the mirror to find the playmate). Both codes were given each time one of the behaviours occurred. The resulting scores are absolute frequencies for each child.

Furthermore, we analysed the toddlers' looking behaviour. We coded the onsets and offsets of the period where the child looks in the mirror and looks at his/her own mirror image. Toddlers' looking behaviour was analysed in two different ways. A rather general score, L_{MIRROR} , was computed indicating the percentage of the whole exposition time (with and without a mark in the face) in which the toddlers were looking in the mirror (not necessarily at their mirror image). Furthermore, we computed the difference score $\Delta_{\text{MI2-MI1}}$. First, a ratio score depicting the percentage of the time the toddlers were looking at their mirror image while in front of the mirror was computed separately for the exposition in front of the mirror with and without mark. Then, the latter was subtracted from the former. Independent of the absolute duration, this score contains the information about whether the toddlers were looking at their mirror image differently after they got the mark in their face. A positive score expresses that a toddler was looking at his or her mirror image for a greater share of the time after having been marked than before. A score of $\Delta_{\text{MI2-MI1}} = .15$, for example, means that with the mark the toddler looks at his or her mirror image 15% more of the exposition time than without the mark.

Inter-rater reliability. The assessments of the rouge test were analysed by a coder who had no information about toddlers' contingency scores. Twenty per cent of the sample were coded by a second rater to assess inter-rater reliabilities. In the case of experimenting behaviour we co-analysed 30% to have more than 25 ratings above zero. To compute reliabilities for the interaction behaviours experimenting and playmate, we segmented the episodes into 30-second intervals and counted the number of experimenting and playmate behaviours per rater. Then we computed Kendall's τ , which is the adequate reliability coefficient for ordinal data. The reliabilities are $\tau = .61$ for experimenting behaviour and $\tau = .75$ for playmate behaviour. For looking behaviour we used an adapted Cohen's kappa score. Basically, for each second the program checked whether looking behaviour was coded or not. Then, on the basis of the contingency table for this dichotomized score,

Cohen's kappa was computed separately for the two looking behaviour scores. Cohen's kappa is $\kappa = .91$ for looking in the mirror and $\kappa = .75$ for looking at the mirror image.

Results

Differences in mothers' contingent responsiveness

To analyse differences between the two samples concerning mothers' contingent responses, we conducted ANCOVAs controlling for a set of variables that may be potential confounds. The variables concerning the toddlers were gender and birth order (first-born or later-born). The variable concerning the mother was education, operationalized as years of schooling z -standardized within cultures. There was a highly significant main effect of culture on contingent responsiveness, $F(1, 44) = 13.49, p < .01$, with German mothers ($M = .23, SD = .16$) showing higher degrees of contingent responsiveness towards their 3-month-old babies than Nso mothers ($M = .07, SD = .16$). The same held for the latency score, indicating the number of latencies per minute with the baby being in an alert positive state. German babies ($M = .97, SD = .99$) experienced significantly more latencies than Nso babies ($M = .39, SD = .42$), $F(1, 46) = 5.44, p < .05$.

Differences in self-recognition

We analysed the distribution of children recognizing and not recognizing themselves in the two cultural samples using a χ^2 -test for this two-by-two contingency table. Whereas the overall percentage of children recognizing themselves was 50.9%, only 3 out of 20 Nso toddlers (15.0%) recognized themselves as compared to 24 out of 33 German toddlers (72.7%). The differences in observed frequencies compared to expected frequencies were highly significant, $\chi^2(1) = 16.61, p \leq .001$. We used Pearson's χ^2 , since no expected frequency was below 5. Cramér's statistic, indicating the degree of association between the two nominal groups, was high with $V_C = .56, p < .001$.

Differences in toddlers' interaction behaviour

Nso toddlers in general showed much less behaviour in front of the mirror. In order to test differences in the general behavioural rate, we defined a score indicating the number of observed behavioural events (playmate, experimenting, pointing to the mark in the mirror or on the face and pointing to the mirror) per minute. The behavioural rate of Nso toddlers ($M = 2.02, SD = 2.18$) was significantly below the behavioural rate

of German toddlers ($M = 5.27, SD = 2.44$), $t(51) = 4.89, p < .001$. Since recognizers were not equiprobable in the two cultural samples it was difficult, looking at self-recognition alone, to say if the differences in the interaction behaviour were due to the development of the categorical self or due to cultural differences.

Experimenting behaviour. Since there was a substantial number of toddlers who did not engage in experimenting behaviour at all, the data were not equally distributed. Therefore, we dichotomized this category in order to contrast toddlers who did not show experimenting behaviour at all to toddlers who showed experimenting behaviour at least once.

To account for the variables self-recognition (recognizer vs. nonrecognizer) and culture (Germans vs. Nso) simultaneously, we used log-linear modelling (GENLOG command in SPSS 11.5). We analysed the relationship between these two variables and experimenting behaviour (no experimenting behaviour vs. experimenting behaviour at least once). Based on our theoretical assumption, we assumed culture to have no effect on experimenting behaviour. Thereby, we only modelled a main effect for self-recognition in the first step to explain the structure of this three-dimensional contingency table.

Testing this restricted model against the saturated model, the likelihood ratio score became significant, $L^2(2, n = 53) = 8.79, p < .05$, indicating a poor fit of the model. After a main effect for culture was entered in the second step, the model was no longer significant, resulting in a good fit, $L^2(2, n = 53) = 0.29, p = .59$. Since goodness of fit was achieved, there was no need to test for the interaction between culture and self-recognition. The parameters estimated were $\lambda = 0.80, p > .05$ for self-recognition and $\lambda = -2.31, p < .01$ for culture. This means that differences in experimenting behaviour could be mainly attributed to culture (see Table 1).

Playmate behaviour. As above, data were not normally distributed so we dichotomized this category and contrasted toddlers who did not show playmate behaviour at all to toddlers who showed playmate behaviour at least once.

Again, we used log-linear analyses to test our hypotheses regarding the influence self-recognition and culture have on playmate behaviour (no playmate behaviour vs. playmate behaviour at least once). We started with our theoretical model specifying only a main effect for self-recognition to explain the structure of this three-dimensional contingency table. The likelihood ratio score became significant, $L^2(2, n = 53) = 13.78, p < .01$, indicating a poor fit of the model. We included a main effect for culture in the second step resulting in a better fit, $L^2(2, n = 53) = 3.71, p = .05$. The parameters estimated were $\lambda = -0.23, p > .05$ for self-recognition and λ

Table 1
Experimenting behaviour within and across cultural communities

| | Culture | | | | | |
|---------------|----------|-------|----------|-------|----------|-------|
| | German | | Nso | | Total | |
| | <i>N</i> | % > 0 | <i>N</i> | % > 0 | <i>N</i> | % > 0 |
| Recognizer | 24 | 91.7 | 3 | 66.7 | 27 | 88.9 |
| Nonrecognizer | 9 | 88.9 | 17 | 35.3 | 26 | 53.8 |
| Total | 33 | 90.0 | 20 | 40.0 | 53 | 71.7 |

% > 0 indicates the percentage of the sample that shows experimenting behaviour at least once.

Table 2
Playmate behaviour within and across cultural communities

| | Culture | | | | | |
|---------------|---------|-------|-----|-------|-------|-------|
| | German | | Nso | | Total | |
| | N | % > 0 | N | % > 0 | N | % > 0 |
| Recognizer | 24 | 83.3 | 3 | 66.7 | 27 | 81.5 |
| Nonrecognizer | 9 | 100 | 17 | 35.3 | 26 | 57.7 |
| Total | 33 | 87.9 | 20 | 40.0 | 53 | 69.8 |

% > 0 indicates the percentage of the sample that shows experimenting behaviour at least once.

= -2.81, $p < .01$ for culture. This means that the main effect of culture accounts for all the differences here. In sum, we did not find much support for our hypotheses concerning the toddlers' experimenting and playmate behaviour. In both cases it was culture and not self-recognition that got a significant parameter estimate in the log-linear analyses. The answer to the question whether experimenting and playmate behaviour occurs at least once or not at all thus could be found rather in cultural differences than in differences regarding self-recognition (see Table 2).

Looking behaviour. Analysing the toddlers' looking behaviour, we computed a 2×2 ANOVA with looking behaviour as the dependent variable. As predicted, this analysis resulted in a significant main effect for self-recognition, $F(1, 49) = 5.35$, $p < .05$. Furthermore, there was a significant main effect for culture, $F(1, 49) = 37.60$, $p < .001$, on looking behaviour. As indicated in Table 3, Nso toddlers in general paid much more attention to the mirror than German toddlers. Since self-recognition was not equiprobable across cultures and there were general cultural differences in the amount of looking behaviour, the mean differences in looking behaviour between recognizers and nonrecognizers for the total sample are deceptive and camouflage the effect self-recognition in fact has on the looking behaviour.

There was a clear pattern of results for the difference score $\Delta_{MI2-MI1}$. Looking at their mirror image, the interest of nonrecognizers slightly decreased whereas interest increased in recognizers. Recognizers looked at their marked mirror image 20% longer than at their unmarked mirror image; this was opposed to nonrecognizers, who showed a 2% decrease in

interest after being marked. As hypothesized, the 2×2 ANOVA design with the difference score $\Delta_{MI2-MI1}$ as the dependent measure yielded a significant main effect for self-recognition on $\Delta_{MI2-MI1}$, $F(1, 49) = 1.49$, $p < .05$.

In sum, recognizers looked at the mirror longer in both samples and furthermore paid more attention to their mirror image after being marked than did nonrecognizers.

Relations between toddlers' behaviour and parenting experiences during infancy

Due to the different exclusion criteria for the two cross-sectional analyses, the final sample for the longitudinal analyses comprised only 36 toddlers (23 German, 13 Nso) of the initial 72. We hypothesized that a higher level of contingency experience is related to earlier self-recognition. Consequently, we specified the directional hypothesis that recognizers experienced more contingent reactions from their mothers at the age of 3 months than nonrecognizers did. The mean differences concerning the responsiveness score indicates that recognizers ($M = .21$, $SD = .18$) experienced more contingent reactions from their mothers with 3 months of age than nonrecognizers ($M = .12$, $SD = .20$), $t(34) = -1.5$, $p < .10$. Additionally, the relative frequency of latencies was significantly higher for recognizers ($M = .94$, $SD = 1.15$) than for nonrecognizers ($M = .43$, $SD = .43$), $t(36) = -1.79$, $p < .05$. Transformed to point-biserial correlation, the coefficients were $r_{pb} = .25$ for the correlation between self-recognition and the responsiveness score and $r_{pb} = .29$ for the correlation between self-recognition and the relative frequency of latencies.

In sum, when mothers' responsiveness had been higher when the child was 3 months it was more likely that the

Table 3
Looking behaviour within and across cultural communities

| Variables | Culture | | | | | | | | |
|-----------------------------|---------|-----|----|-----|-----|----|-------|-----|----|
| | German | | | Nso | | | Total | | |
| | M | SD | N | M | SD | N | M | SD | N |
| Look in mirror L_{Mirror} | | | | | | | | | |
| Recognizer | .57 | .15 | 24 | .86 | .12 | 3 | .60 | .17 | 27 |
| Nonrecognizer | .41 | .15 | 9 | .78 | .14 | 17 | .65 | .22 | 26 |
| Total | .53 | .17 | 33 | .79 | .14 | 20 | .63 | .20 | 53 |
| $\Delta_{MI2-MI1}$ | | | | | | | | | |
| Recognizer | .22 | .23 | 24 | .08 | .25 | 3 | .20 | .23 | 27 |
| Nonrecognizer | -.06 | .15 | 9 | .00 | .15 | 16 | -.02 | .15 | 25 |
| Total | .14 | .25 | 33 | .01 | .16 | 19 | .10 | .23 | 52 |

L_{Mirror} : $t(31) = -2.74$, $p < .05$ for the German sample.

toddlers would recognize themselves at the age of 18 to 20 months.

Discussion

With the present study we would like to contribute to the understanding of the impact culture has on children's behavioural development. We assumed that the experience of contingent responsiveness during infancy is related to the timing of toddlers' self-recognition. We expected German infants to experience significantly more contingent responsiveness in face-to-face interactions with their mothers. This was confirmed for both measures, Watson's responsiveness score and the relative number of latencies per minute.

We then analysed 18- to 20-month-old toddlers' self-recognition in the mirror recognition task. There are marked differences between the two samples, with German toddlers recognizing themselves far more often than Nso toddlers. This result supports our hypothesis that the early development of a mental model of the self is culturally prioritized in urban German middle-class families.

In order to substantiate the mirror recognition data, we further analysed the interaction behaviour of the toddlers in front of the mirror. In line with the literature, we assumed that children who recognize themselves show more experimenting and less playmate behaviour than children who do not recognize themselves. Our results reveal that we have to differentiate this view. The differences found in experimenting and playmate behaviour were attributable to culture rather than to self-recognition. Nso toddlers generally show much less behaviour than German toddlers in front of the mirror. Only 40% of the Nso sample showed experimenting or playmate behaviour at least once, compared to 88% of the German participants. With respect to the looking behaviour of toddlers, we found an effect of self-recognition; recognizers look in the mirror longer than nonrecognizers do. Furthermore, Nso toddlers were looking in the mirror much longer than the German toddlers. This finding is complementary to the fact that Nso toddlers show less expressive behaviour. Nso toddlers just stand in front of the mirror and look in it, for an average of 79% of the exposition time, as compared to only 53% of the exposition time in the case of the German toddlers, who in addition explore the surroundings or engage in something else while being in front of the mirror. This finding clearly supports our hypothesis that recognizers pay more attention to their mirror image after being marked than nonrecognizers.

The fact that the behavioural rates in front of the mirror of the Nso children are significantly lower than those of the German children reflects a complex interplay between behavioural rates, parenting strategies, and toddlers' developmental achievements. Our study design does not allow us to disentangle these complexities. Nevertheless, the Cameroonian children who recognize themselves show higher behavioural rates than the Cameroonian children who do not recognize themselves. Longitudinal research is needed in order to better understand these complexities.

The longitudinal analysis revealed that there are relationships in the expected direction between the early experience of contingency and toddlers' self-recognition. We found a significant relation between the relative number of latencies per minute and self-recognition at the age of 18 to 20 months. The fact that the relation between Watson's responsiveness

score and self-recognition reached significance only on a marginal level is probably related to the fact that the actual longitudinal sample only comprises 36 toddlers, who in addition are unequally distributed across the two samples (23 German and 13 Nso).

Our results extend earlier findings that the experience of different parenting systems (Keller, 2002) has developmental consequences for toddlers' behavioural achievements (Keller et al., 2004b). Our results demonstrate that the interactional mechanism of contingency also has a differential impact on children's development. Contingent responsiveness during face-to-face exchange primes the infant's understanding of causality. The prompt response within the memory span of the infant allows the perception of the maternal action as related to their own behaviour. Expectations about environmental control that are part of a sense of autonomy can be developed. Contingent responsiveness also supports the perception of clear boundaries of the self and thus of being a distinct and separate person (Keller et al., 1999).

However, our results cannot be interpreted as demonstrating inferiority of the Cameroonian Nso socialization strategy or delayed developmental processes of Nso toddlers. The results demonstrate that cultural environments differ in terms of the emphasis they put on the timing of developmental tasks in line with their socialization goals and their conceptions of self and competence (Keller, 2003; Keller et al., 2004b). Children who predominantly experience body contact and body stimulation during infancy, like Nso infants, develop patterns of social regulation, like compliance, earlier than toddlers who predominantly experience face-to-face contact and object stimulation, like Greek middle-class infants (Keller et al., 2004b). The different socialization strategies find their expression in precociousness (LeVine & Norman, 2001) in particular developmental domains in different cultural environments. Cultural environments with an independent sociocultural orientation emphasize autonomy and separateness as socialization goals so that parenting strategies should serve to accelerate self-recognition. Cultural environments with an interdependent sociocultural orientation emphasize relatedness and heteronomy as socialization goals so that parenting strategies should serve to accelerate self-regulation. In an earlier study we could demonstrate these differences accordingly (Keller et al., 2004b). It can also be assumed that contingent responsiveness can be expressed in other parenting systems than the face-to-face context. Future studies should be aimed at analysing contingencies in bodily regulations to develop a better understanding of the effects of interactional mechanisms. The idea that cultural emphases accelerate domain-specific developments across cultural environments is further supported by cross-cultural differences in the expectation mothers have concerning the age at which children master developmental milestones in infancy. Several studies have demonstrated that parents with independent sociocultural orientations expect cognitive competencies earlier than parents with interdependent sociocultural orientations, who expect social competencies earlier (e.g., Goodnow, Cashmore, Cotton, & Knight, 1984; Joshi & MacLean, 1997; Keller, Miranda, & Gauda, 1984; Ninio, 1979; Pomerleau, Malcuit, & Sabatier, 1991). Our results extend these findings to differences in the actual behaviour displayed by the toddlers.

Although our study contributes to the understanding of culturally informed developmental pathways, the assessment of self-recognition needs to be further studied in different cultural

contexts. The first aspect that needs attention is the fact that human infants (as well as great apes) experience considerable instability in the development of mirror self-recognition (Bard, 2004; Bischof-Köhler, 1989; Mitchell, 1993; Tomonaga et al., 2004; Zazzo, 1982). Mark-directed behaviour may co-occur concurrently with reaching behind the mirror, i.e. playmate behaviour. Calling their own image by the name of a sibling or friend may also co-occur with self-directed behaviours (Hart & Fegley, 1994). In order to study the hypothesis that mirror recognition is a first expression of a mental model of the self, other behavioural achievements of that developmental time span have to be assessed concurrently, like parameters of social interaction, deception, gestural imitation (Hart & Fegley, 1994), self-descriptive language in free play (Kagan, 1989), naming pictures of oneself, and the use of personal pronouns (Lewis & Brooks-Gunn, 1979). Concomitant with mirror recognition, the expression of embarrassment as a self-related emotion also has been described (Richman et al., 1983). Universal development milestones like the development of a mental model of the self may not only have a different timing across cultural communities, but may also be rooted in different behavioural patterns. More longitudinal research cross-cultural as well as with intraculturally more diverse communities is needed in order to better understand culturally informed developmental pathways.

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