

Culture-Specific Development of Early Mother-Infant Emotional Co-Regulation: Italian,  
Cameroonian, and West African Immigrant Dyads

November 19, 2018

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

### Abstract

Studies conducted in Western countries document the special role of mother-infant face-to-face exchanges for early emotional development including social smiling. A few cross-cultural studies have shown that the western pattern of face-to-face communication is absent in traditional rural cultures, without identifying other processes that promote emotional co-regulation. The present study compared three different samples: Western middle-class families in Italy, rural traditional Nso farmer families in Cameroon, and West African sub-Saharan immigrant families in Italy using biweekly observations of 20 mother-infant dyads from each cultural context from age 4 to 12 weeks. Longitudinal sequential analysis of maternal and infant behaviors showed that from as early as 4 weeks, in Italian dyads maternal affectionate talking is linked with infant active attention to mother in sequences of face-to-face contact; this link fosters the subsequent emergence of infant smiling/cooing, and then sequences of positive feedback between infant and maternal emotional expressions that, by the 3rd month, dynamically stabilize. In contrast, for Cameroonian/Nso dyads over the 2nd and 3rd month, maternal motor stimulation marked by rhythmic vocalizing is linked with infant active attention to surroundings. The relatively few smiling/cooing actions of Nso babies at their mothers were answered mainly with tactile stimulation that did not foster the maintenance of face-to-face visual contact. Finally, West African immigrant dyads showed a combination of both face-to-face and sensorimotor co-regulated exchanges observed in their new and native cultures. These findings suggest that emotional co-regulation in early infancy can occur via multiple, culture-specific pathways that may be substantially different from the western pattern of face-to-face communication.

*Keywords:* early mother-infant emotional co-regulation; culture; emotional expressiveness; emotion socialization; acculturation

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

### Culture-Specific Development of Early Mother-Infant Emotional Co-Regulation: Italian, Cameroonian, and West African Immigrant Dyads

This study aims to deepen our understanding of how culture shapes emotional development via patterns of parent-infant emotional co-regulation from as early as the first months of life.

Co-regulation (Fogel, 1993) is a continuous process of mutual adjustment by which partners in interaction, such as parent and infant, alter their actions with respect to the ongoing (and anticipated) actions of the other. Although this concept has been developed and studied in Western countries, we assume that it could be fruitfully used to study early emotional development in different cultural groups because the process of co-regulation plays a crucial role in early emotional development for at least two reasons. First, although young infants are provided with impressive capabilities to interact with caregivers, their immaturity constrains their self-regulatory abilities (Beegly, Fuertes, Liu, Delonis, & Tronick, 2011); caregivers, therefore, can play a critical role in helping them to regulate negative emotions and maintain emotional states of “well-being together.” Second, the caregivers’ own emotional expression during caregiver-infant interaction and their responses to the infant’s emotional expressions—responses that can encourage or dull their infant’s emotions—provide the infant with continuous feedback about what kinds of emotion and emotional expression are appropriate (Camras, Shuster, & Fraumeni, 2014). As a consequence of co-regulated interaction, caregiver-infant dyads create their patterns of emotional communication (Hsu & Fogel, 2003; Lavelli & Fogel, 2013)—highly repetitive sequences of mutually regulated behaviors—that organize the infant’s emotional experience with the world (Tronick & Beegly, 2011).

Infant studies conducted in Western countries document that emotional co-regulation takes place primarily in the context of mother-infant face-to-face exchanges. This pattern of

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

emotional co-regulation emerges toward the end of the 2nd month, when a major transformation in neural functions (Herschkowitz, Kaga, & Zilles, 1997) provides the infant with new capacities to engage in social interaction, such as sustained visual attention and social smiling (Lavelli & Fogel, 2005; Rochat & Striano, 1999).

Co-regulation processes and the formation of interactional patterns are most effectively studied by sequential analysis (Bakeman & Quera, 2011), that is, the analysis of the infant's behavior occurring as a function of the preceding caregiver's behavior during interaction, and vice versa. This specific analysis focuses on real-time, live interactional sequences of caregiver's and infant behaviors. It thus differs substantially from methods based on rating scales and measures created by summarizing across an entire observation session.

In Western middle-class families, the only milieu in which we have sequential analyses of mother-infant emotional co-regulation over the first three months of life (Lavelli & Fogel, 2005, 2013), we found systematic patterns of emotional development: after a phase of mutual attentiveness, a pattern of face-to-face exchange of positive emotions begins around 6-8 weeks. At this time, infant smiling and cooing appear in a context of maternal positive emotional expressions (Messinger & Fogel, 2007) and foster maternal 'mirroring' (Gergely & Watson, 1999), that is, maternal contingent reflecting of the infant's facial and vocal actions. Maternal mirroring, in turn, encourages the infant's positive emotional expressiveness (Lavelli & Fogel, 2013). Interestingly, maternal mirroring was found to occur selectively for infant expressions of positive emotions (Malatesta & Haviland, 1982).

Among contemporary scholars, however, there is agreement that interactional patterns between caregivers and infants vary grossly across cultures. There is substantial evidence indicating that the prevalence of face-to-face visual and vocal exchanges as the major behavior channels for emotional co-regulation is rather the exception than the norm on a world wide scale (Cole & Moore, 2015; Halberstadt & Lozada, 2011; Kärtner, Holodynski, &

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

Wörmann, 2013; Tronick & Beegly, 2011). Caregivers' behaviors related to emotion socialization reflect underlying cultural beliefs on emotional expressiveness and emotion-related values (Camras et al., 2014; Friedlmeier, Corapci, & Cole, 2011; Keller & Kärtner, 2013; Keller & Otto, 2009), these are, in turn, informed by socialization goals emphasized by the sociocultural context. In Western middle-class cultures, the uniqueness of the individual as an independent agent with her own wishes, preferences and intentions is promoted in the exchange of positive emotions during early face-to-face communication, considered to be an effective way to encourage personal autonomy. Indeed, the expression of emotions is understood as a medium of self-expression (Mesquita, 2001) and the experience of positive emotions is maximized (Friedelmeyer et al., 2011) and fostered as a vital support for developing self-reliance (Markus & Kitayama, 1994).

A few cross-cultural studies have shown that this pattern of early face-to-face exchange of positive emotions is largely absent in non-Western traditional rural cultures that emphasize relatedness based on hierarchical roles (Keller & Kärtner, 2013) and promote socialization goals such as obedience, respect for elders, and control of individual emotional expressiveness as regulation in close knit social systems. In particular, well-known studies (LeVine et al., 1994) conducted among the Gusii, a subsistence-based farming community in Kenya, documented that Gusii mothers show emotional restraint with their young infants and looked away from them just as the infants displayed peaks of positive affect. More recent studies compared early mother-infant interaction in Cameroonian Nso farmer families—for whom the cultural expectation of a good child is a calm child (Keller & Otto, 2009)—and in German urban middle-class families—where the cultural expectation is of a child capable of expressing her own wishes and emotional states; although both Nso and German infants showed a similar sharp increase in awake alertness at 2 months, the Nso did not increase the duration of mother-infant mutual gaze and positive affect as the Germans did (Kärtner,

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

Keller, & Yovsi, 2010; Wörmann, Holodynski, Kärtner, & Keller, 2012, 2014). Similar results were found with rural Fijian mothers responding less contingently to their infants' positive vocal bids than American upper-middle class mothers (Broesch, Rochat, Olah, Broesch, & Henrich, 2016). Also Hindu Indian mothers and their infants in Gujarat displayed low levels of positive emotional expressiveness in interactional situation since open display of emotions is regarded as culturally inappropriate (Abels et al., 2005).

If parent-infant face-to-face exchange of positive affect typical for Western middle-class families is not universal, it leaves open the question of (whether and) how non-Western traditional rural cultures promote emotional socialization, i.e., how emotional co-regulation during early infancy is achieved. There is some indication of more proximal contingent responsiveness, characterized by body contact and body stimulation (Kärtner et al., 2010; Keller, 2007), in sociocultural contexts based on hierarchical social relations. However, the studies have focused mainly on patterns of maternal contingent responsiveness to their infants' communicative signals and failed to examine the mutual influence of maternal and infant behaviors in developing patterns of emotional co-regulation across the first postnatal months.

With this study we therefore want to contribute to the literature by using longitudinal observational measures and sequential analysis to investigate how mother-infant emotional co-regulation may create unique pathways of emotional development over the first months of life in different cultural groups.

Cross-cultural comparisons need to be driven by conceptually based selections of cultural groups. This strategy necessitates to lay open the underlying definition of culture. We employ a conception of culture as shared values, norms and beliefs (representational level) and shared behaviors (action level) of people living in similar sociodemographic milieus. Sociodemographic milieus are organized by the level of formal education which has been

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

demonstrated to affect life and family strategies (Bongaarts, 2003; Ní Bhrolcháin & Beaujouan, 2012). Higher levels of formal education drive later first parenthood, fewer children and a nuclear, two-generation household. Lower levels of formal education as in subsistence based farming families drive early first parenthood, more children and extended multi generation households. These dimensions exert additive and interactive effects shaping infants' learning environment with consequences for children's development (Keller et al., 2004). The cross-cultural design of our study compares mother-infant interaction in free play situation in three cultural groups: higher educated Italian middle-class families, lower educated Northwest Cameroonian Nso farmer families and West African immigrant families in Italy. Italian middle-class families were found to follow socialization goals representing psychological autonomy (Carra et al., 2013), in line with Western middle-class families. Their socialization goals differ substantially from those of rural subsistence based farmers like the Northwest Cameroonian Nso, who are oriented towards relatedness based on hierarchical roles (Keller & Kärtner, 2013). The autochthonous Italian and Nso families can thus be expected to embody substantially different emotion co-regulation. West African immigrant families shared the same or similar (see Method-Participants) cultural origins with the Cameroonian Nso and lived in the same area as the Northern Italian middle-class families, thus sharing with them the public and institutional culture. The immigrant families may advance our understanding of human emotional development as environmentally labile by demonstrating how behavioral regulations related to emotion socialization may be modified after migration to a new cultural environment. In particular, comparing immigrant families with families in the new country allow us to see changes in emotion socialization strategies as adaptations to the new environment, and comparing immigrant families with families in the culture of origin allows us to identify continuity and maintenance. Generally, studies with immigrants have revealed a combination of processes of continuity and change

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

(Bornstein & Bohr, 2011; Liu, Yang, Fang, Snidman, & Tronick, 2013). However, the combinations of old and new patterns may be manifold (Carra, Lavelli, Keller, & Kärtner, 2013; Keller, 2007) and more observational research focused on mother-infant co-regulation processes is needed in order to better understand its structure and dynamics.

We decided to study mother-infant interaction, although the Nso, like many other traditional farming communities in non-Western cultures, have a multiple caretaking system with mainly children caring for babies (see Scheidecker, 2017). However, previous studies with Nso farmers have demonstrated that mother-infant interactional patterns exert influence on children's development (Keller, 2007; Keller et al., 2004).

In line with general differences in socialization goals and parenting strategies, emotion regulation and expression in parent-infant interaction can be expected to differ between these groups. Italian culture in particular, encourages emotional expressiveness in interpersonal interaction (Bornstein et al., 2012). Expressiveness in terms of liveliness (the *vivace* child) has been indicated as one of the main developmental goals for Italian infants (Axia & Weisner, 2002). Italian mothers prefer active and reactive over quiet and passive infants, because liveliness is considered an index of being healthy and lovable. In contrast, the Nso culture encourages early emotional control with a special emphasis on the prevention of negative emotions, because crying could indicate health problems and risks for survival in a disease-prone environment (Keller & Otto, 2009). Furthermore, a calm infant allows the mother to do her daily chores and can be cared for by multiple caregivers (Keller & Otto, 2009). Finally, for immigrant families from cultures where emotional control is prevalent, the experience of being exposed to openly expressed emotions in their new environment may be disturbing (Röttger-Rössler & Lam, 2018). On the other hand, immigrants have to deal with different emotional vocabularies, especially in preparing their children for the future in the new environment. Camras, Shuster and Fraumeni (2014) conclude from existing studies –



## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

mainly with South-East Asian or Latino migrants into the USA “..that emotion-socialization attitudes fall somewhere in between those characterizing their culture of origin and their culture of destination.”(p.76). There are no studies to date addressing emotional socialization in African-heritage migrants in Western countries. This comparison is assumed to be particularly informative because two substantially different cultural models meet. It can be expected that processes of change and continuity become more visible in this context compared to cultures that share more commonalities.

Observations took place before, during, and after the main neural and behavioral change occurring toward the end of the 2nd month (Rochat & Striano, 1999), indexed by the onset of social smiling, in order to assess similarities and differences in developmental changes of emotional co-regulation in the three contexts. Because of the different sociocultural contexts, and because of our focus on both facial and non-facial maternal and infant behaviors, mothers were not constrained to a face-to-face interaction but were free to choose a typical setting for interacting with their infants. This also allowed us to retain ecological validity in collecting data in such different cultures.

We addressed the following specific aims:

1. Preliminary to the analysis of mother-infant emotional co-regulation, we document and compare the average durations of emotional expressions shown by infants during interaction with their mothers across age—from 4 to 12 weeks—and cultural groups. We expected increases in arousal and emotional engagement in interaction in all groups of infants around 6-8 weeks (main developmental change), but culture-specific ways of expressing and developing their engagement.

2. We document and compare the average durations of maternal behavioral patterns during interaction with their infants across age (4-12 weeks) and cultural groups. We expected Italian mothers to show a significant increase of affectionate responsive behaviors

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

that paralleled the infants' increased emotional engagement around 6-8 weeks, as documented in the literature. Furthermore, we expected no main behavioral changes in Nso mothers, as infant smiling and cooing are only marginally important in cultures where control of emotional expressiveness is highly valued. Finally, we expected immigrant mothers to show behaviors observable in both their original and new cultures.

3. We investigate and compare mother-infant emotional co-regulation (i.e., significant transitional probabilities between maternal and infant behaviors) using sequential analysis in each of the three groups of dyads across age (4-12 weeks). The analysis is aimed to examine (a) whether specific patterns of emotional co-regulation develop in different sociocultural contexts, and (b) if specific co-regulated patterns were found, when and how they develop and stabilize or change across the considered age range. We expected to find culture-specific patterns based on emotion-related values and socialization strategies: face-to-face exchanges of positive emotions in Western/Italian dyads (as documented in previous studies), emotional closeness in body contact and body stimulation in Cameroonian/Nso dyads, and combinations of behavioral patterns from the culture of origin (particularly those more bound up with traditional beliefs) and the new culture in immigrant dyads. Furthermore, considering what may be universal in processes that lay foundation for early emotional development, we expected co-regulated patterns to arise around 6-8 weeks in all groups because of the main behavioral change in infants.

### **Method**

#### **Participants**

Twenty Italian mother-infant dyads, 20 West African first-generation immigrant mothers and their infants born in Italy, and 20 Cameroonian Nso dyads participated in the study. Both the Italian and the immigrant dyads lived in Mantua and Verona, two medium-sized cities in northern Italy. West African mothers came from rural (30%) and urban (70%) areas of

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

Nigeria (55%), Ghana (30%), and the English-speaking area of Cameroon (15%) where the Nso dyads lived. Since it was not possible to reach a sufficient number of Cameroonian Nso families in Northern Italy, we expanded our sample to include Anglophone Nigerian and Ghanaian families from the sub-Saharan area of West Africa. It can be assumed that the sub-Saharan farmers in different countries share basic childrearing attitudes and practices (Amos, 2013; LeVine et al., 1994; Nsamenang, 1993; Rabain-Jamin & Wornham, 1990). Indeed, interviews on parenting ethnotheories conducted with this sample of West African immigrant mothers (Carra, Lavelli, & Keller, 2014) revealed similar beliefs and socialization strategies. The Nso dyads lived in small villages near Kumbo, Bui Division of the Northwest Province of Cameroon. The Nso are an ethnic group with a subsistence-based economy and an extended family system in which several generations share everyday activities, including child care. However, although the Nso infants are socialized in a dense social network with multiple caregivers, their mothers are regularly in touch with them during the first months of life (Yovsi, Kärtner, Keller, & Lohaus, 2009), as in the Italian and the immigrant sociocultural contexts.

The research project “Early development of intersubjectivity: Universality and culture specificity” was given ethics approval according to the AIP (Italian Psychological Association) ethical principles regarding research with human participants. With regard to the data collected in the Nso villages in Cameroon, we had the permission of the Fon (king) of the Nso prior to the research starting. All of the mothers were first contacted during the last trimester of pregnancy through municipal hospitals in Mantua and Verona and through the health center in Kumbo. After the birth of their children, mother-infant dyads were selected from the pool of Italian and immigrant mothers interested in participating in the study, on the basis of (a) absence of obstetrical and neurological complications (spontaneous full-term delivery; physiological birth weight above 2,500 g; 1-min and 5-min Apgar scores  $\geq 8$ ); (b)

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

absence of medical indications of physical or psychological problems on the part of the mother; (c) initial disposition of the mother to breastfeed; (d) couple relationship between the infant's mother and father; (e) both the mother and the father being of age and Italian or Cameroonian/Nigerian/Ghanaian, and living in Italy for at least 1 year. In Cameroon, in the Nso rural community, mothers were further contacted and informed by a native Nso research assistant only after the head of the village approved their participation in the study. Interested mothers participated with the consent of their family heads.

Western urban middle-class families like our Italian sample and subsistence based farmers in non-Western countries like the Cameroonian Nso follow two clearly distinct socialization strategies that are rooted in different sociodemographic profiles. Indeed, the Nso mothers had received less formal education ( $M = 7.89$  years,  $SD = 1.88$ ) than both the Italian mothers ( $M = 15.55$  years,  $SD = 2.31$ ),  $t(38) = 11.22$ ,  $p < .001$ ,  $d = 1.82$ , and the immigrant mothers ( $M = 11.85$  years,  $SD = 4.03$ ),  $t(38) = 3.89$ ,  $p < .001$ ,  $d = 0.67$ , who came from both rural and urban areas. The immigrant mothers had received less formal education than the Italian mothers,  $t(38) = 3.56$ ,  $p = .001$ ,  $d = 0.58$ , and were also significantly younger ( $M = 28.75$  years,  $SD = 6.44$ ) than the Italians ( $M = 33.20$  years,  $SD = 4.20$ ),  $t(38) = 2.59$ ,  $p = .014$ ,  $d = 0.42$ . The difference in age between Nso ( $M = 29.25$ ,  $SD = 8.23$ ) and Italian mothers was not statistically significant. Finally, only 20% of Nso mothers and 35% of immigrant mothers vs. 65% of Italian mothers were primiparous,  $\chi^2(2) = 8.75$ ,  $p = .013$ . These sociodemographic profiles also represent cultural milieus with particular learning contexts for children (Keller, 2018a). We ran a correlation analysis between maternal age, years of formal education, parity, and social context (urban vs. rural). Significant correlations between social context and both maternal formal education and parity,  $r(57) = .479$ ,  $p < .001$ , and  $r(58) = .371$ ,  $p = .004$ , and between maternal formal education and maternal age at the infant's birth,  $r(57) = .285$ ,  $p = .035$ , substantiate the claim of interdependency between these sociodemographic

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

dimensions. Thus, we do not regard these dimensions as variables to control for individually (Keller et al., 2009).

Infant gender was balanced within and across samples (Italian: 50% girls; immigrant: 50% girls; Nso 60% girls). Finally, immigrant mothers had been living in Italy for an average of almost 7 years ( $M = 82.35$  months,  $SD = 53.10$ ; range 1-13 years) when they gave birth to the infants included in this study.

### **Procedure**

All the mother-infant dyads were followed longitudinally through biweekly videotaped observations of spontaneous mother-infant interaction in a naturally-occurring context at their home, from 4 to 12 postnatal weeks. In Italy the research assistant made a preliminary home visit to both Italian and immigrant dyads between the 2nd and 3rd week after the infant's birth, in order to familiarize the mothers with the research. Conversations with West African immigrant mothers were in English or Italian, according to their preference. During this visit, mothers were asked to fill in the Informed Consent to data processing according to the law. Furthermore, a questionnaire concerning sociodemographic information was administered. In the Nso community a cultural native research assistant who was familiar with the participant families made all video-recordings and collected sociodemographic information during the first visit.

**Videotaping.** At each visit, mothers were asked in their native language (Italian or Lamnso for the Nso) or in English (used with the immigrant mothers) to interact with their infants as they usually do. The mothers were free to choose a typical setting, but not to include others in the interaction. Because of the importance of behavioral states for young infants' responsiveness, for videotaping the infant needed to have been fed and to be in alert state. Mother-infant spontaneous interaction was videotaped for 5 minutes using a hand-held camera with a built-in microphone at a distance of approximately 2-3 m, in order to get the

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

best view of both infants' and mothers' faces and bodies (upper part for mothers), and to adapt to their movements.

**Coding.** Considering that gaze direction and emotional expression are the main indicators of the engagement of an infant of 1-3 months in social interaction, infant behaviors were coded into categories of Gaze Direction (at mother's face vs. at environment/object) and categories of Emotional Expressions (including active attention, expressions of positive affect, neutral or fussy/crying expressions) adapted from Lavelli and Fogel (2005). Detailed descriptions of these categories are given in Appendix A.

Maternal behaviors were coded using a culture-sensitive coding system (Carra, Lavelli, & Keller, 2013) devised to capture the variety of emotional expressions and actions shown by mothers in the different sociocultural contexts. To this end, in addition to maternal distal behaviors (gazing, facial and vocal behaviors) typically coded in Western cultures, maternal proximal behaviors such as body contact and motor stimulation, typical of subsistence based rural cultures, were included in the coding system. In particular, mothers' behaviors addressed to the infant were coded into categories included in six sub-systems corresponding to the parenting systems described by Keller (2007): Gazing and Facial Behaviors (Face-to-Face Contact), Vocal Behaviors (Narrative Envelope), Body Contact, Body Stimulation, Object Stimulation, and Primary Care. Detailed descriptions of the categories of maternal behaviors are given in Appendix B. The coding was performed using the INTERACT 9.1 software, with a continuous event coding strategy. The minimum duration required for coding was 1 s.

**Reliability.** A random sample of 45 out of 300 sessions (15% for each group of dyads) was coded by a second independent observer in order to calculate intercoder reliability. Each time the two independent coders entered the same code with less than 1.5 seconds of difference, it was considered agreement, otherwise as a disagreement. A lapse of 1.5 s was set

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

because 1 s was the minimum duration for coding, consistently with other studies. The average Cohen's Kappa for infant behaviors was .84 for Gaze Direction, and .73 for Expressive Configuration; for maternal behaviors it was .76 for Gazing and Facial Behaviors, .73 for Vocal Behaviors, .85 for Body Contact, .78 for Body Stimulation, .90 for Object Stimulation, and .87 for Primary Care.

### **Preliminary Analysis: Identification of Infant and Maternal Behavioral Patterns**

In order to analyze mother-infant emotional co-regulation, we needed a limited number of target variables, that is, discrete maternal and infant behaviors (composed of emotional expressions, gaze direction and actions) that could be used in a sequential analysis of mutual responses during interaction. Thus, as a preliminary step we identified the main behavioral patterns shown by infants and mothers in the different cultural contexts. These target variables were then used for all analyses. With regard to the infants' behaviors, at first some behavioral categories were merged with others because of their emotional meaning (Smiling grouped with Cooing because both express positive affect) or their low frequency (Gaze at Object grouped with Gaze at Environment, and Fussy/cry-state-related expression—absent in the most of the infants—included in Neutral expression because observed a few times as pre-cry face that turned fast into Neutral). Then, infant behavioral patterns were identified as 'joint states', or couplings, of gaze direction and emotional expression shown by infant at the same time (i.e., where the infant was gazing while she was showing a certain expression) during interaction. The analysis of co-occurrences (GSEQ 5.1, Bakeman & Quera, 2011) between 2 categories of infant gaze direction (at Mother vs. surrounding Environment) and 3 categories of infant emotional expressions (Neutral, ActiveAttention, Smiling/Cooing) produced the following 6 'joint states': Neutral Expression Gazing at Environment/(Object), Active Attention to Environment/(Object), Smiling/Cooing Gazing at Environment/(Object),

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

Neutral Expression Gazing at Mother's face, Active Attention to Mother's face, and Smiling/Cooing at Mother's face.

With regard to maternal behaviors, as a first step to identify recurrent behavioral patterns, from all possible combinations of co-occurring behaviors showed by mothers during interaction with their infants we selected the most frequent combinations (i.e., those with durations of at least 1,000 s). Then, we pulled the most recurrent combinations into a limited number of behavioral patterns on the basis of their functional meaning, checked through the literature and repeated watching of the videotaped sessions. Since Body Contact (either whole or moderate) was included in all identified behavioral patterns but in very different proportions across cultural groups, total durations of Body Contact were added as a separate pattern in order to compare this specific mode of emotional regulation across time and cultural contexts. The identified maternal behavioral patterns—labelled 'Body Contact', 'Gazing', 'Affectionate Talking/Smiling', 'Motor Stimulation/Rhythmic Vocalizing', 'Tactile Stimulation', and 'Object Stimulation'—are defined in Table 1.

Insert Table 1 about here

### **Results**

#### **Developmental Changes in Infant Behaviors in the Three Cultural Contexts**

At first, in order to model the developmental trajectories of infants' and mothers' behavioral patterns across age in the different groups (Aims 1 and 2), we ran repeated measures multilevel models with age at level 1 nested within subjects-level 2, and, respectively, specific maternal or infant behaviors as covariates using MPLUS (ref.). We used MLR estimators because infant and mother behaviors were often not normally distributed. However, the multilevel modeling approach failed due to lack of model convergence for several behaviors.



## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

We therefore computed a series of repeated measures analyses of variance (ANOVAs) on ranked data (Gallucci, Leone, & Berlingeri, 2017) with age (4, 6, 8, 10, 12 weeks) as the within-subject factor, and cultural group (Italian, West African immigrant, Nso) as the between-subject factor. A Bonferroni adjustment was applied to the level used for significance (corrected critical  $p$  value = .0033), because of the multiple comparisons. Paired  $t$ -tests were used as post-hoc test within group, and Bonferroni as post-hoc test across groups. Finally, a retrospective power analysis was run using G\*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007). Power analysis allowed us to estimate the probability of correctly rejecting the null hypothesis when it was false, and indicated that all significant ( $\alpha = .0033$ ) results have power  $(1-\beta) = 1$ .

Descriptive statistics and results from repeated measures ANOVAs computed for each of infant behavioral patterns across age and cultural groups are presented in Table 2. The results indicate a significant main effect for group for the most of the infant behavioral patterns, and a age x group interaction effect for smiling/cooing at the mother's face (Figure 1). Post hoc comparisons indicate that infants in both Nso and immigrant groups showed significantly longer durations of active attention to surrounding environment than did Italian infants,  $M_{\text{NSO}} - M_{\text{IT}} = 60.76$ ,  $t(57) = 4.68$ ,  $p < .001$ , and  $M_{\text{IM}} - M_{\text{IT}} = 44.82$ ,  $t(57) = 3.58$ ,  $p = .002$ . On the contrary, Italian infants showed significantly longer durations of active attention and smiling/cooing at their mothers, than did infants in both Nso and immigrant groups,  $M_{\text{IT}} - M_{\text{NSO}} = 65.23$ ,  $t(57) = 8.72$ ,  $p < .001$ ,  $M_{\text{IT}} - M_{\text{IM}} = 37.04$ ,  $t(57) = 4.14$ ,  $p < .001$ ;  $M_{\text{IT}} - M_{\text{NSO}} = 61.27$ ,  $t(57) = 9.53$ ,  $p < .001$ ,  $M_{\text{IT}} - M_{\text{IM}} = 44.29$ ,  $t(57) = 4.78$ ,  $p < .001$ . Differences for smile/cooing at the mother's face were significant from as early as 6 weeks, coincident with the onset of social smiling,  $M_{\text{IT}} - M_{\text{NSO}} t(249) = 5.63$ ,  $p < .001$ ,  $M_{\text{IT}} - M_{\text{IM}} t(249) = 3.93$ ,  $p = .009$ , and increased further by 8 weeks only between Italian and Nso infants,  $M_{\text{IT}} - M_{\text{NSO}} t(249) = 7.15$ ,  $p < .001$ . Interestingly, infants from immigrant families

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

showed significantly longer durations of active attention and smiling/cooing at mother than did Nso infants, ActAtt  $M_{IM} - M_{NSO} = 28.19$ ,  $t(57) = 4.58$ ,  $p < .001$ , and Smil/Coo  $M_{IM} - M_{NSO} = 16.98$ ,  $t(57) = 4.74$ ,  $p < .001$ . Looking at maternal behaviors and at mother-infant body contact and body orientation help to interpret infants' behaviors.

### **Developmental Changes vs. Stability in Maternal Behaviors in the Three Cultural Contexts**

Descriptive statistics and results from repeated measures ANOVAs computed for maternal behavioral patterns across age and cultural groups are presented in Table 3. The results show a significant main effect for group for each of these patterns and a age x group interaction effect for body contact (Figure 2) and tactile stimulation. Regardless of the infant age, body contact was continuous in Nso mother-infant dyads—with infant held by mother or sitting on her legs, often facing outwards—and almost continuous in West African immigrant dyads, albeit significantly less than in the Nso,  $M_{NSO} - M_{IM} = 22.94$ ,  $t(57) = 4.19$ ,  $p < .001$ . Conversely, time spent in body contact by Italian dyads was significantly shorter than in the other groups,  $M_{NSO} - M_{IT} = 177.27$ ,  $t(57) = 9.98$ ,  $p < .001$ , and  $M_{IM} - M_{IT} = 154.33$ ,  $t(57) = 5.80$ ,  $p < .001$ ; differences were significant starting from 6 weeks,  $M_{NSO} - M_{IT}$   $t(249) = 6.36$ ,  $p < .001$ ,  $M_{IM} - M_{IT}$   $t(249) = 4.12$ ,  $p = .005$ , when infants began to smile and Italian mothers increased significantly the duration of affectionate talking/smiling within a setting of face-to-face communication. Italian mothers provided their infants with significantly greater proportions of affectionate talking and visual contact for face-to-face communication than did Nso mothers,  $M_{IT} - M_{NSO} = 121.4$ ,  $t(57) = 10.34$ ,  $p < .001$ , and West African immigrant mothers,  $M_{IT} - M_{IM} = 101.9$ ,  $t(57) = 4.61$ ,  $p < .001$ . Nevertheless, the latter talked and smiled affectionately significantly more than did Nso mothers,  $M_{IM} - M_{NSO} = 19.5$ ,  $t(57) = 5.73$ ,  $p < .001$ .

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

It is interesting, however, to note that Nso and West African immigrant mothers showed little changes in their behaviors across age, regardless of changes in infant behaviors. The main behavioral pattern of interaction shown by these mothers was motor stimulation—mainly the practice of lifting the baby up and down, and shaking or rocking her back and forth—marked by rhythmic vocalizing. Motor stimulation was practiced by both Nso and immigrant mothers with durations significantly longer than the short motor exercises (infant's limb movements) provided by Italian mothers,  $M_{\text{NSO}} - M_{\text{IT}} = 92.66$ ,  $t(57) = 9.45$ ,  $p < .001$ , and  $M_{\text{IM}} - M_{\text{IT}} = 121.4$ ,  $t(57) = -10.34$ ,  $p < .001$ . Italian mothers, in turn, provided their infants with significantly greater proportions of tactile stimulation (caresses, kisses, little pats) than did the other mothers,  $M_{\text{IT}} - M_{\text{NSO}} = 57$ ,  $t(57) = 6.69$ ,  $p < .001$ , and  $M_{\text{IT}} - M_{\text{IM}} = 44.45$ ,  $t(57) = 3.65$ ,  $p = .002$ ; differences were significant with both groups only at 4 weeks,  $M_{\text{IT}} - M_{\text{NSO}}$   $t(57) = 6.40$ ,  $p < .001$ , and  $M_{\text{IT}} - M_{\text{IM}}$   $t(57) = 3.83$ ,  $p = .016$ . Finally, Italian mothers also provided their infants with object stimulation significantly more than the Nso mothers,  $M_{\text{IT}} - M_{\text{NSO}} = 35.42$ ,  $t(57) = 5.82$ ,  $p < .001$ .

Additional analyses were conducted by correlating the durations of both maternal and infant behavioral patterns with maternal sociodemographic characteristics. The results show that keeping maternal age, formal education, parity, and social context in the same analysis, main maternal and infant behavioral patterns are significantly correlated with both maternal education and social context; however, when maternal education is controlled for context, the significant correlations decrease. These findings further substantiate that differences in behavioral patterns are related to sociodemographic profiles representing different cultural contexts, rather than to single variables.

Insert Tables 2 and 3, and Figures 1 and 2 about here

### **Real-Time Relationships Between Maternal and Infant Behaviors, and Developing Patterns of Emotional Co-Regulation in the Different Cultural Contexts**

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

A sequential analysis (GSEQ, Bakeman & Quera, 2011) was performed on the infant's behaviors as *target* and maternal behaviors as *given*, and vice versa, to assess any significant transitional probability between maternal and infant behaviors, and then possible patterns of emotional co-regulation, in each of the three groups of dyads across time. The analysis was performed on each cultural group separately. The significance of transitional probabilities was assessed by the adjusted residuals statistics (Bakeman & Quera, 2011).

Figures 3, 4, and 5 synthesize the mean transitional probabilities between maternal and infant behaviors found to be significant in Italian, Cameroonian/Nso dyads, and West African immigrant, respectively. In Italian dyads (Figure 3), as early as 4 weeks the presence of maternal affectionate talking and smiling significantly affected the occurrences of infant active attention to the mother's face, which, conversely, contributed to maintain maternal affectionate talking. This bidirectional sequential pattern in face-to-face context laid the foundation for a new pattern of emotional co-regulation based on the exchange of positive emotions. This arose at 6 weeks, when the emergence of infant smiling—linked to maternal smiling during affectionate talking—significantly affected the occurrences of maternal mirroring the infant's smiles. This, in turn, affected the infant's repetition of mirrored smiling and attempts to vocalize positive affect, giving rise to sequences of positive feedback between maternal and infant emotional expressions. By 8 weeks this pattern increased in complexity—further nurtured by the infant's sustained active attention and vocalizations of positive affect—and in the following weeks dynamically stabilized. In addition, Figure 3 shows that Italian mothers also stimulated their infant's attention with objects from as early as 4 weeks, but that a bidirectional sequential pattern between maternal object stimulation and infant active attention to the object emerged only at 12 weeks, nurtured by the infant expression of pleasure in the situation.

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

In Cameroonian/Nso mother-infant dyads (Figure 4) the way of being together and co-regulating emotional engagement was different from that of Italian dyads. At 6 weeks, the emergence of infant smiling at the mother's face (rather infrequent given the few opportunities of face-to-face contact) significantly affected the occurrence of maternal reply with looming and kisses on the infant's cheek, or with other forms of tactile response such as caresses or affectionate taps on the infant's face. This proximal response, in turn, significantly affected the infant to turn her head away from the mother, and turn off the smile looking elsewhere. A significant probability of occurrences of maternal tactile responses after infant smile at mother was still observed at 8 weeks, but no more across the third month. However, a main pattern of emotional co-regulation based on motor stimulation was observed from 6 to 12 weeks in Nso dyads. Starting from 6 weeks, maternal vestibular/motor stimulation marked by rhythmic vocalizing significantly affected the occurrence of infant active engagement: increased arousal indexed by facial and body actions and active attention to surrounding environment, given the infant's orientation outwards; the infant engagement, in turn, cycled with maternal motor stimulation by providing the mother with continuous feedback on the infant state. During this practice, the experience of being moved or rocked according to the rhythm of maternal vocalizing provided the infant with experience of synchrony (emotional closeness) with her mother.

Finally, with regard to emotional co-regulation shown by West African immigrant dyads (Figure 5), it is interesting to observe the presence of both the main patterns shown by Nso and Italian mother-infant dyads. Similarly to Italian dyads, as early as 4 weeks the presence of maternal affectionate talking significantly affected the occurrence of infant gazing at the mother's face (with no particular facial actions) while the infant's expression of active attention contributed to maintain maternal affectionate talking and smiling. In the following weeks maternal affectionate talking continued to elicit active attention on the part of the

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

infant, and by the end of the second month it was bidirectionally linked with infant smiling and/or cooing at mother in brief sequences of face-to-face exchanges of positive affect, which stabilized across the third month. A more stable pattern of emotional co-regulation shown by West African immigrant dyads across the period of observation (starting from the sixth week) was similar to that above described for the Nso dyads, based on motor stimulation. However, inspection of videos revealed an interesting difference: in the immigrant context, during vestibular/motor stimulation the infant was often oriented toward mother, with the possibility of mutual gaze interspersed with body movements. Sometimes, this allowed the dyads to combine motor stimulation and face-to-face contact in longer sequences of emotional co-regulation, such as when after lifting up the infant to an upright position the mother lowered the infant onto her laps and both paused in face-to-face contact, sharing positive affect.

A repeated measure ANOVA applied to the adjusted residuals of the bidirectionally significant transitional probabilities between mother's and infant's behaviors confirmed that the three cultural groups differ significantly in their patterns of emotional co-regulation. A Bonferroni comparison across groups served as a post-hoc test. A significant main effect for group was found for the bidirectional sequential patterns between maternal affectionate talking/smiling and both infant active attention to the mother's face and smiling/cooing at mother, both being significantly more present in Italian dyads than in Cameroonian/Nso dyads,  $MAffTalkSm \rightarrow IActivAttMoth$   $F(2, 57) = 7.56, p = .001, \eta_p^2 = .22, M_{IT} - M_{NSO} = 1.11, t(57) = 3.83, p < .001$ ;  $IActivAttMoth \rightarrow MAffTalkSm$   $F(2, 57) = 6.40, p = .003, \eta_p^2 = .19, M_{IT} - M_{NSO} = 0.92, t(57) = 3.55, p = .002$ ;  $MAffTalkSm \rightarrow ISmilCooMoth$   $F(2, 57) = 7.35, p = .001, \eta_p^2 = .21, M_{IT} - M_{NSO} = 1.31, t(57) = 3.54, p = .002$ ;  $ISmilCooMoth \rightarrow MAffTalkSm$   $F(2, 57) = 7.80, p = .001, \eta_p^2 = .22, M_{IT} - M_{NSO} = 1.50, t(57) = 3.76, p = .001$ . Interestingly, the co-regulated exchange of positive emotions was significantly more present in immigrant dyads in Italy than in Cameroonian/Nso dyads,  $MAffTalkSm \rightarrow ISmilCooMoth$   $M_{IM} - M_{NSO} =$

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

1.16,  $t(57) = 3.12$ ,  $p = .009$ ; ISmilCooMoth $\rightarrow$ MAffTalkSm  $M_{IM} - M_{NSO} = 1.20$ ,  $t(57) = 3.00$ ,  $p = .012$ . In addition, a significant main effect for group was found for the bidirectional sequential patterns between maternal motor stimulation marked by rhythmic vocalizing and infant active attention to surrounding environment, significantly more present in the Nso dyads than in the Italian, MMotStim $\rightarrow$ IactivAttE/Ob  $F(2, 57) = 4.21$ ,  $p = .020$ ,  $\eta_p^2 = .13$ ,  $M_{NSO} - M_{IT} = 1.00$ ,  $t(57) = 2.90$ ,  $p < .016$ ; IactivAttE/Ob $\rightarrow$ MMotSt  $F(2, 57) = 4.21$ ,  $p = .020$ ,  $\eta_p^2 = .13$ ,  $M_{NSO} - M_{IT} = 1.00$ ,  $t(57) = 2.90$ ,  $p = .016$ .

Insert Figures 3, 4, and 5 about here

### Discussion

In this study, we investigated how early mother-infant emotional co-regulation shapes pathways of emotional development over the first trimester of life, in three cultural contexts: two contexts (the Italian middle-class and the Nso farmer families) with different cultural models of emotion socialization, and a context (the West African immigrant families in Italy) undergoing change between the two cultures. To address our goal, we first documented how infant and maternal behavioral patterns (emotional expressions and actions) during interaction changed across age and cultural contexts. Then, sequential analysis of maternal and infant behaviors during interaction in each of the cultural groups across age allowed us to identify culture-specific patterns of emotional co-regulation and pathways of early emotional development.

#### **Emotional Expressiveness and Culture-Specific Patterns of Emotional Co-Regulation**

As expected, infants in all cultural contexts showed an increase in the duration of active attention and engagement in interaction coincident with the neural and behavioral transformations indexed by the onset of social smiling, around 6-8 weeks, but significant differences in emotional expressiveness. These differences are understandable in the light of the different cultural contexts which inform caregivers' emotion socialization strategies (cf.

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

Introduction). In Italian culture the infant's smiling and cooing at mother is welcomed and encouraged as an index of liveliness and self-expression (Bornstein et al., 2012). In contrast, in the Nso culture, because of the cultural expectation for a calm child (Keller & Otto, 2009), the infant's emotional expressions are not reciprocated by adults, so that Nso infants learn in the first few months to display sober faces, as shown by our findings.

In particular, the use of longitudinal sequential analysis allowed us to document how culture-specific patterns of mother-infant emotional co-regulation develop in different sociocultural contexts and how they shape early emotional development. These patterns are clearly observable as early as 6-8 weeks, when infants become more actively engaged in social interaction. Italian dyads display the well-known pattern of joyful emotional exchange based on visual contact between two distinct partners; the infant is treated as a quasi-equal partner with her own wishes and intentions. Positive feedback between infant and maternal emotional expressions fosters the infant's emotional expressiveness and ability to initiate positive communicative exchanges, which are main developmental goals for Italian infants (Axia & Weisner, 2002; Bornstein, Cote, & Venuti, 2001; Bornstein et al., 2012).

In contrast, the Nso dyads display a main pattern of vestibular/motor stimulation promoting experience of mother-infant synchronization through the rhythmic structure of maternal movements and vocalizing. The experience of emotional co-regulation is asymmetrical: the mother takes the lead by structuring the interaction, whereas the infant adjusts her position and movements following maternal rhythms; however, the mother constantly monitors the infant's bodily and vocal/facial expressions, in order to scaffold the infant's overcoming of negative emotions. Interestingly, this aim was explicitly explained by West African immigrant mothers interviewed about their parenting ethnotheories (Carra et al., 2014), when they reported that the practice of lifting the baby up is intended to train the infant to overcome fear and become strong and courageous. The Nso infant spends much of



## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

her time in body contact with her mother (Keller, 2018b), as it was found in other traditional rural farmer cultures (Chapin, 2013), and her bodily expressions are monitored much more by maternal bodily attention than by visual attention. Body contact provides the infant with the experience of interactional warmth, and interactional warmth has been found to foster early development of self-regulation and compliance with parents' messages and values (Keller et al., 2004; Kochanska & Thompson, 1997; McDonald, 1992), which are the main developmental goals for Nso infants (Nsamenang & Lamb, 1994).

Finally, West African immigrant mothers and their infants born in Italy display patterns of emotional co-regulation that fall in between those observed in Nso (culture of origin) and Italian (culture of destination) dyads, as hypothesized (see below the paragraph on acculturation processes).

Taken together, these findings can change the way we usually think about mother-infant emotional co-regulation as a face-to-face mutual exchange based on visual contact between quasi-symmetrical partners, by showing that co-regulation can develop between not facing partners and the process can be asymmetrical with the mother leading, although constantly monitoring and co-regulating according to the infant's bodily and vocal or facial expressions. Early emotional co-regulation would therefore be better thought as a subtle mutual feedback of movements, postures, body – not only facial/vocal – expressions that occurs between embodied human beings as a way to share and negotiate emotional states. In addition, these findings can change the way we think about cultural variations in mother-infant emotional co-regulation, by advancing our understanding beyond the "simple" distinction between distal channels of co-regulation used in Western middle-class families and proximal channels used in non-Western traditional rural cultures, for at least two reasons. First, because findings from sequential analysis allowed us to identify a specific pattern of proximal co-regulation: the rhythmic-synchronous motor stimulation, observed in the Nso

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

group and, with some variations (see below), in the West African immigrant group. Second, because the findings show evidence that not only different sensory/behavioral channels of co-regulation are preferred in different cultural contexts, but also different modalities to communicate through the same channels, such as the rhythmic vs. non-rhythmic mode of vocalizing, or the vestibular/motor vs. tactile mode of body stimulation.

### **Acculturation Processes in Emotional Co-Regulation**

The inclusion of an immigrant group in our research design allowed us to advance our understanding of the labile/adaptive nature of human emotional development by revealing how emotional expressiveness and behavioral regulation related to emotion socialization may be modified in a short time (the group was first-generation immigrant) after migration to a new cultural environment. In particular, the use of longitudinal sequential analysis of mother-infant emotional co-regulation allowed us to shed light on the processes indexing cultural change and capture important variations in culture-based behaviors that add to the literature a unique contribution. The results show patterns of mother-infant emotional co-regulation based on behaviors typical of the original culture and the new culture. The high proportions of body contact and rhythmic motor stimulation, consistent with behaviors of West African immigrant mothers in France (Rabain-Jamin & Wornham, 1990), are understandable considering that in sub-Saharan African communities body/motor stimulation is the embodiment of good parenting (Lohaus et al., 2011). However, two clear indices of cultural change emerged from our analysis: maternal emotional expressiveness, particularly the expressiveness of positive emotionality, and the infant's postural orientation toward the mother, crucial for the possibility of visual contact. Particularly during vestibular/motor stimulation, the orientation toward the mother provided the infant with possibility of face-to-face emotional sharing interspersed with body movements, suggesting that in the process of acculturation aspects of the original culture and of the host culture may be combined into new creative blends, as it

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

was recently proposed (Benet-Martínez & Haritatos, 2005; Chen, Benet-Martínez, & Bond, 2008; de Haan, 2011).

### **Culture-Specific Pathways of Emotional Development**

Our study has demonstrated that early emotional co-regulation through which infants are socialized develops within different behavioral channels and modalities in different cultural communities. These differences can be related to different conceptions of self and others prevalent in these communities and adapted to different demands of life. Italian middle-class children learn that they are independent, self-contained agents whose individuality and uniqueness is supported by emotional expressiveness, in particular positive emotions. Their active role in structuring the interactional exchange and their mothers responsive sensitivity to their facial and vocal emotional expressions foster the early development of an independent self in relation with others. The Nso farmer children, on the other hand, learn early to be part of a community or a social action by the experience of synchrony with their social partners. The synchronous regulation is embedded in bodily proximity, which represents the major behavior channel. Body contact and bodily proximity transmit warmth literally, which may foster feelings of belongingness.

Our results open questions about whether these two pathways are functionally equivalent and represent comparable kinds of emotional regulation and development. Cross-cultural emotion studies have suggested that it is not only the expressiveness of emotions that differs across cultures, but also the experience of emotions itself, and its intensity (Lim, 2016). Moreover, cultures differ with respect to focal emotions, that is, emotions on which socialization strategies are centered (e.g., Kitayama, Mesquita & Karasawa, 2006; Röttger-Rössler et al., 2013). The study of acculturation in the immigrant group suggests that infants in immigrant families may develop behavioral patterns encouraged in different cultures in an integrated way.

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

### **Conclusion**

This study contributes to the understanding of emotional development on a global scale. Documenting different, culture-specific developmental pathways of emotional co-regulation suggests that monocultural studies cannot describe processes of emotional development in a general way and puts into perspective those existing conceptions that rest on the assumptions of WEIRD (Western, Educated, Industrialized, Rich, Democratic, Henrich, Heine & Norenzayan, 2010) psychology. Cross-cultural comparisons are therefore crucial for understanding general principles of emotional development. Based in ecocultural perspective (Keller & Kärtner, 2013), we selected three samples for our study that have been shown to follow different developmental agendas with different socialization goals. North Italian middle-class families follow the expected Western middle-class pattern of child centred emotional expressiveness in the face-to-face modus responsive to children's maturational progress. Cameroonian Nso farmers demonstrate proximal emotional regulation with rhythmical synchronization guided by maternal structuring. This strategy is based in body contact as the prevalent parenting system. The expression of closeness and interpersonal warmth through close bodily monitoring and regulating together with facial inexpressiveness characterizes many non-Western rural farming contexts where socialization goals of social cohesion and communality are promoted. Migrants coming from non-Western countries into Western societies have been shown to develop hybrid patterns integrating bodily closeness and rhythmicity with face-to-face affective expressiveness. Thus two behavioral systems are combined that are particularly salient in the strategies of origin. This result offers new insights into processes of cultural change and continuity in immigration contexts.

The results of our study demonstrate how cultural influences impinge on biological predispositions, molding developmental pathways in line with wider cultural models from birth on. Comparing different developmental pathways helps in understanding commonalities

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

and differences and thus it contributes to the advancement of a global theory of emotional regulation and its development, and recognizes variability as the human condition.

Our longitudinal cross-cultural design is complemented by innovative analyses. The use of a cultural-sensitive coding system allowed us to go profitably beyond the traditional focus on facial actions in order to code emotional expression, and to document the dimensions of bodily closeness and rhythmical synchronization as crucial to early mother-infant emotional co-regulation in a non-Western rural culture. In particular, the use of longitudinal sequential analysis allowed us to capture the process of mother-infant emotional co-regulation in different cultural groups and the different, culture-specific ways in which it develops from as early as the first months of life. This method provides a new approach to the study of emotional development from a cultural point of view, suggesting that cultural differences in early emotional development can be analyzed by comparing patterns of emotional co-regulation and how they develop in different sociocultural contexts.

Finally, our findings have educational implications for Italian professionals in health and early childhood education who work with West African immigrant families. Indeed, these findings can inform about emotion-related values and socialization practices in the culture of origin of these immigrant families, thus enhancing the cultural sensitivity of these professionals and reducing potential sources of misunderstanding.

Our study has also limitations. Our ecocultural approach necessitates homogeneous samples based on sociodemographic characteristics. The participating families of the autochthonous Northern Italian and the Nso samples could be composed following this strategy. The immigrant sample deviates in some respects. The mothers differ in years of formal education and accordingly rural or urban background in the country of origin. Moreover, they differed in their exposure to Italian mainstream culture (range 1-13 years). We selected first-generation West African Anglophone migrant families, because previous

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

studies have demonstrated similarities in socialization goals and strategies across different sub-Saharan cultures. This compromise was necessary as finding enough Nso first-generation families with a newborn baby was not possible, even when different European countries were taken into consideration. Nevertheless the immigrant sample allowed to draw a consistent pattern.

### **Future Directions**

Our research points to the importance of cross-cultural comparisons in the study of emotional development. On the basis of our work, we suggest future research to employ a sociodemographically based concept of culture for future comparison. This implies to select cultural groups conceptually defined by sociodemographic milieus, which also represent specific learning environments for children (cf. Introduction pp. 6-7). Future cultural studies should attend to different subsistence groups (foragers, fishermen, herders) in order to find variability in sociodemographic milieus, that is, clearly differentiated cultural contexts for new comparisons. Particularly we need more studies including immigrant groups compared with groups sharing the culture of origin and the new culture; the two autochthonous groups should live in substantially different sociocultural contexts, in order to deepen our understanding of the influence of the cultural context (the new one with different sociodemographic characteristics) on emotion regulation and its development. To this aim, future studies should overcome the limitations of our work by selecting more homogeneous immigrant samples in parents' years of formal education, background (rural vs. urban) in the country of origin, and length of stay in the new country. Future research should also investigate early emotional co-regulation in multiple generations of immigrant families in order to advance our knowledge of the processes of cultural change and continuity in emotion socialization.

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

'Co-regulation' measured by sequential analysis in a longitudinal design was a powerful conceptual and methodological tool to study caregiver-infant emotional co-regulation and how early patterns of co-regulation may shape specific pathways of emotional development in different cultural groups. In future studies this sequential, real-time analysis should be profitably complemented by a multilevel modeling analysis in order to depict developmental trajectories of infants' and caregivers' behaviors across age and to document through a global measure whether infant behavior changes as a function of caregiver's behavior and vice versa. *Brief sentence on changes to the design that could help to face with problems of model convergence emerged in our study.* Finally, future research guided by a cross-cultural approach to the study of early emotional development could benefit from the use of mixed-method designs combining quantitative and qualitative analyses; the latter, informed by ethnographic knowledge about the cultures considered, should be used to substantiate and deepen the understanding of quantitative results. Understanding the beginning of emotional developmental pathways *across cultures (?)* would further allow to address questions relating to the relationships between the early interactional regulatory processes and emotional experience and expressions during later developmental phases.

**References**

- Abels, M., Keller, H., Mohite, P., Mankodi, H., Shastri, J., Bhargava, S., ... Lakhani, A. (2005). Early socialization contexts and social experiences of infants in rural and urban Gujarat, India. *Journal of Cross-Cultural Psychology*, 36, 717-738.  
doi:10.1177/0022022105280511
- Amos P. M. (2013). Parenting and culture—evidence from some African communities. In M. L. Seidl-De-Moura (Ed.), *Parenting in South American and African contexts*. IntechOpen.  
doi:10.5772/56967
- Axia, V. D., & Weisner, T. S. (2002). Infant stress reactivity and home cultural ecology of Italian infants and families. *Infant Behavior and Development*, 25, 255-268.  
doi:10.1016/S0163-6383(02)00099-1
- Bakeman, R., & Quera, V. (2011). *Sequential analysis and observational methods for the behavioral sciences*. Cambridge, UK: Cambridge University Press.
- Beeghly, M., Fuertes, M., Liu, C.H., Susan Delonis M., & Tronick, E. (2011). Maternal sensitivity in dyadic context: Mutual regulation, meaning-making, and reparation. In D. Winders Davis & M. C. Logsdon (Eds.), *Maternal sensitivity: A scientific foundation for practice* (pp. 45-70). New York: Nova Science.
- Benet-Martínez, V., & Haritatos, J. (2005). Bicultural identity integration (BII): Components and psychosocial antecedents. *Journal of Personality*, 73, 1015-1050. doi:10.1111/j.1467-6494.2005.00337.x
- Bongaarts, J. (2003). Completing the fertility transition in the developing world: The role of educational differences and fertility preferences. *Population Studies*, 57, 321-335.
- Bornstein, M. H., & Bohr, Y. (2011). Immigration, acculturation and parenting. In R. E. Tremblay, M. Boivin, & R. DeV. Peters (Eds.), M. H. Bornstein (topic Ed.), *Encyclopedia*



## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

*on Early Childhood Development*. Retrieved from <http://www.child-encyclopedia.com/immigration/according-experts/immigration-acculturation-and-parenting.pdf>

- Bornstein, M. H., Cote, L. R., & Venuti, P. (2001). Parenting beliefs and behaviors in northern and southern groups of Italian mothers of young infants. *Journal of Family Psychology, 15*, 663-675. doi:10.1037/0893-3200.15.4.663
- Bornstein, M. H., Putnick, D. L., Suwalsky, J. T. D., Venuti, P., de Falco, S., Zingman de Galperín, C., ... Heslington Tichovolsky, M. (2012). Emotional Relationships in Mothers and Infants: Culture-Common and Community-Specific Characteristics of Dyads From Rural and Metropolitan Settings in Argentina, Italy, and the United States. *Journal of Cross-Cultural Psychology, 43*, 171-197. doi: 10.1177/0022022110388563
- Broesch, T., Rochat, P., Olah, K., Broesch, J., & Henrich, J. (2016). Similarities and differences in maternal responsiveness in three societies: Evidence from Fiji, Kenya, and the United States. *Child Development, 87*, 700-711. doi:10.1111/cdev.12501
- Camras, L. A., Shuster, M. M., & Fraumeni, B. R. (2014). Emotion socialization in the family with an emphasis on culture. *Contributions to Human Development, 26*, 67-80. doi:10.1159/000354355
- Carra, C., Lavelli, M., & Keller, H. (2012). *Cross-cultural coding scheme for mothers' behaviors during spontaneous interaction with their infants*. Unpublished manuscript. University of Verona & University of Osnabrück.
- Carra, C., Lavelli, M., & Keller, H. (2014). Practices of body stimulation during the first 3 months: Ethnotheories and behaviors of Italian mothers and West African immigrant mothers. *Infant Behavior & Development, 37*, 5-15. doi: 10.1016/j.infbeh.2013.10.004
- Carra, C., Lavelli, M., Keller, H., & Kärtner, J. (2013). Parenting infants: Beliefs and behaviors of Italian mothers and immigrant mothers from West Africa. *Journal of Cross-Cultural Psychology, 44*, 1304-1320. doi: 10.1177/002202 2113486004

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

- Chapin, B.L. (2013). Attachment in rural Sri Lanka: The shape of caregiver sensitivity, communication, and autonomy. In N. Quinn & J. M. Mageo (Eds.), *Attachment reconsidered: Cultural perspectives on a Western theory* (pp. 143-165). New York: Palgrave Macmillan.
- Chen, S. X., Benet-Martínez, V., & Bond, M. H. (2008). Bicultural identity, bilingualism, and psychological adjustment in multicultural societies: Immigration-based and globalization-based acculturation. *Journal of Personality*, *76*, 803-838. doi:10.1111/j.1467-6494.2008.00505.x
- Cole, P. M., & Moore, G.A. (2015). About face! Infant facial expression of emotion. *Emotion Review*, *7*, 116-120. doi:10.1177/1754073914554786
- de Haan, M. (2011). The reconstruction of parenting after migration: A perspective from cultural translation. *Human Development*, *54*, 376-399. doi:10.1159/000334119
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G\*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.
- Fogel, A. (1993). *Developing through relationships*. Chicago: University of Chicago Press.
- Friedlmeier, W., Corapci, F. & Cole, P.M. (2011). Socialization of emotions in cross-cultural perspective. *Social and Personality Psychology Compass*, *5*, 410-427. doi:10.1111/j.1751-9004.2011.00362.x
- Gallucci, M., Leone, L., & Berlingeri, M. (2017). *Modelli statistici per le scienze sociali [Statistical models for social sciences]*. Milano-Torino: Pearson Italia, 2nd ed.
- Gergely, G., & Watson, J. S. (1999). Early socio-emotional development: Contingency perception and the social-biofeedback model. In P. Rochat (Ed.), *Early social cognition: Understanding others in the first months of life* (pp. 101-136). Mahwah, NJ: Erlbaum.

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

- Halberstadt, A. G., & Lozada, F. T. (2011). Emotion development in infancy through the lens of culture. *Emotion Review*, 3, 158-168. doi:10.1177/1754073910387946
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, 33, 1-75. doi:10.1017/S0140525X0999152X
- Herschkowitz, N., Kagan, J., & Zilles, K. (1997). Neurobiological bases of behavioral development in the first year. *Neuropediatrics*, 28, 296-306. doi:10.1055/s-2007-973720
- Hsu, H., & Fogel, A. (2003). Social regulatory effect of infant nondistress vocalization on maternal behavior. *Developmental Psychology*, 39, 976-991. doi:10.1037/0012-1649.39.6.976
- Kärtner, J., Holodynski, M., & Wörmann, V. (2013). Parental ethnotheories, social practice and the culture-specific development of social smiling in infants. *Mind, Culture and Activity*, 20, 79-95. doi:10.1080/10749039.2012.742112
- Kärtner, J., Keller, H., & Yovsi, R. D. (2010). Mother-infant interaction during the first three months: The emergence of culture-specific contingency patterns. *Child Development*, 81, 540-554. doi:10.1111/j.1467-8624.2009.01414.x
- Keller, H. (2007). *Cultures of infancy*. Mahwah, NJ: Erlbaum.
- Keller, H. (2018a). Parenting and socioemotional development in infancy and early childhood. *Developmental Review*, <https://doi.org/10.1016/j.dr.2018.03.001>
- Keller, H. (2018b). The role of emotions in socialization processes across cultures. Implications for theory and practice. In Matsumoto, D., & Hwang, H. (Eds.), *Oxford handbook of culture and psychology (2nd ed)*. Oxford, UK: Oxford University Press.
- Keller, H., Borke, J., Staufenbiel, T., Yovsi, R. D., Abels, M., Papaligoura, Z., ... Su, Y. (2009). Distal and proximal parenting as two alternative parenting strategies during infant's early months of life. A cross-cultural study. *International Journal of Behavioral Development*, 33, 412-420. doi:10.1177/0165025409338441

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

- Keller, H., & Kärtner, J. (2013). Development. The cultural solution of universal developmental tasks. In M. Gelfand, C. Y. Chiu, & Y. Y. Hong (Eds.), *Advances in Culture and Psychology, Vol. 3* (pp. 63-116). New York: Oxford University Press.
- Keller, H., & Otto, H. (2009). The cultural socialization of emotion regulation during infancy. *Journal of Cross-Cultural Psychology, 40*, 996-1011. doi:10.1177/0022022109348576
- Keller, H., Yovsi, R., Borke, J., Kärtner, J., Jensen, H., & Papaligoura, Z. (2004). Developmental consequences of early parenting experiences: Self-recognition and self-regulation in three cultural communities. *Child Development, 75*, 1745-1760. doi:10.1111/j.1467-8624.2004.00814.x
- Kitayama, S., Mesquita, B. & Karasawa, M. (2006). Cultural affordances and emotional experience: socially engaging and disengaging emotions in Japan and the United States. *Journal of Personality and Social Psychology, 91*, 890-903. doi: 10.1037/0022-3514.91.5.890
- Kochanska, G., & Thompson, R. A. (1997). The emergence and development of conscience in toddlerhood and early childhood. In J. E. Gusec & L. Kuczynski (Eds.), *Parenting and children's internalization of values: A handbook of contemporary theory* (pp. 53-77). New York: Wiley.
- Lavelli, M., & Fogel A. (2005). Developmental changes in the relationship between the infant's attention and emotion during early face-to-face communication: The 2-month transition. *Developmental Psychology, 41*, 265-280. doi:10.1037/0012-1649.41.1.265
- Lavelli, M., & Fogel A. (2013). Interdyad differences in early mother-infant face-to-face communication: Real-time dynamics and developmental pathways. *Developmental Psychology, 49*, 2257-2271. doi:10.1037/a0032268

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

- LeVine, R. A., Dixon, S., LeVine, S., Richman, A., Leiderman, P. H., Keefer, C. H., & Brazelton, T. B. (1994). *Child care and culture: Lessons from Africa*. New York: Cambridge University Press.
- Lim, N. (2016). Cultural differences in emotion: differences in emotional arousal level between the East and the West. *Integrative Medicine Research, 5*, 105-109. doi: doi.org/10.1016/j.imr.2016.03.004
- Lohaus, A., Keller, H., Lamm, B., Teubert, M., Fassbender, I., Freitag, C., ... Schwarzer, G. (2011). Infant development in two cultural contexts: Cameroonian Nso farmer and German middle-class infants. *Journal of Reproductive and Infant Psychology, 29*, 148-161. doi:10.1080/02646838.2011.558074
- Liu, C. H., Yang, Y., Fang, S., Snidman, N., & Tronick, E. (2013). Maternal regulating behaviors through face-to-face play in first and second-generation Chinese American and European American mothers of infants. *Research in Human Development, 10*, 289-307. doi:10.1080/15427609.2013.846042
- MacDonald, K. B. (1992). Warmth as a developmental construct: An evolutionary analysis. *Child Development, 63*, 753-773. doi:10.1111/j.1467-8624.1992.tb01659.x
- Malatesta, C. Z., & Haviland, J. M. (1982). Learning display rules: The socialization of emotion expression in infancy. *Child Development, 53*, 991-1003. doi:10.1111/1467-8624.ep8587636
- Markus, H. R., & Kitayama, S. (1994). The cultural construction of self and emotion. Implications for social behavior. In S. Kitayama & H. R. Markus (Eds.), *Emotion and culture: Empirical studies of mutual influence* (pp. 89-130). Washington D.C.: American Psychological Association.
- Mesquita, B. (2001). Emotions in collectivist and individualist contexts. *Journal of Personality and Social Psychology, 80*, 68-74. doi:10.1037/0022-3514.80.1.68

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

- Messinger, D., & Fogel, A. (2007). The interactive development of social smiling. In R. V. Kail (Ed.), *Advances in child development and behavior* (Vol. 35, pp. 327-366). San Diego, CA: Elsevier Academic Press.
- Nsamenang, A. B. (1993). Psychology in Sub-Saharan Africa. *Psychology and Developing Societies*, 5, 171-184. doi:10.1177/097133369300500205
- Nsamenang, A. B., & Lamb, M. E. (1994). Socialization of Nso children in the Bamenda grassfields of Northwest Cameroon. In P. M. Greenfield, & R. R. Cocking (Eds.), *Cross-cultural roots of minority child development* (pp. 133-146). Hillsdale, NJ: Erlbaum.
- Ní Bhrolcháin, M., & Beaujouan, É. (2012). Fertility postponement is largely due to rising educational enrolment. *Population Studies*, 66, 311-327.
- Rabain-Jamin J., & Wornham, W. L. (1990). Transformations of maternal behaviors and caregiving in immigrant women from West Africa. *La Psychiatrie de l'Enfant*, 33, 287-319.
- Rochat, P., & Striano, T. (1999). Social cognitive development in the first year. In P. Rochat (Ed.), *Early social cognition* (pp. 3-34). Hillsdale, NJ: Erlbaum.
- Röttger-Rössler, B., & Lam, A. A. T. (2018). Germans with parents from Vietnam: The affective dimensions of parent-child relations in Vietnamese Berlin. In B. Röttger-Rössler, & J. Slaby (Eds.), *Affect in relation. Families, places, technologies* (pp. 72-90). Abingdon, NY: Routledge.
- Röttger-Rössler, B., Scheidecker, G., Jung, S. & Holodyski, M. (2013). Socializing emotions in childhood: A cross-cultural comparison between the Bara in Madagascar and the Minangkabau in Indonesia. *Mind, Culture, and Activity*, 20(3), 260-287.  
doi:10.1080/10749039.2013.806551
- Scheidecker, G. (2017). *Kindheit, Kultur und moralische Emotionen: Zur Sozialisation von Furcht und Wut im ländlichen Madagaskar*. Bielefeld, Germany: Transcript Verlag.

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

- Tronick, E. Z., & Beeghly, M. (2011). Infants' meaning-making and the development of mental health problems. *American Psychologist, 66*, 107-119. doi:10.1037//a0021631
- Wörmann, V., Holodynski, M., Keller, H. & Kärtner, J. (2012). A cross-cultural comparison of the development of the social smile. A longitudinal study of maternal and infant imitation in 6- and 12-week-old infants. *Infant Behavior & Development, 35*(3), 335-47. doi:10.1016/j.infbeh.2012.03.002
- Wörmann, V., Holodynski, M., Kärtner, J., Keller, H. (2014). The emergence of social smiling: The interplay of maternal and infant imitation during the first three months in cross-cultural comparison. *Journal of Cross-Cultural Psychology, 45*(3), 339-361. doi:10.1177/0022022113509134
- Yovsi, R. D., Kärtner, J., Keller, H., & Lohaus, A. (2009). Maternal interactional quality in two cultural environments. German middle class and Cameroonian rural mothers. *Journal of Cross-Cultural Psychology, 40*, 701-707. doi:10.1177/0022022109335065

**Appendix A**

**Categories of Infant Behavior during Mother-Infant Interaction**

Infant Behaviors	Description
<b>I. Gazing Directions</b>	
1. Gazing at the surrounding environment	The infant is gazing at the surrounding environment, either with or without a focal point.
2. Gazing at the mother's face	The infant is gazing at the mother's face.
3. Gazing at the object	The infant is gazing at the object included in the interaction. <i>Example:</i> The infant is gazing at a toy that is shown by her mother.
<b>II. Emotional expressions</b>	
1. Neutral	Relaxed neutral expression, with possible visual attention, in a quiet alert state.
2. Active attention	Sustained-active visual attention indexed by different types of brow- and eye actions, such as brow raising and eye widening (as in fascinated fixation) or brow knitting (as in effortful concentration), both accompanied by quiet motor activity; brow-raising movements accompanied by motor activity and possible excitement are also included.
3. Smiling	Relaxed expression of positive affect indexed by smiling with mouth partially or totally open (i.e., regardless of intensity).
4. Cooing expression	Approaching positive expression indexed by lip shaping for cooing (upper lip raising and protruding or lip prespeech movements) either with or without actual vocalizing, accompanied by possible approaching postural orientation. Vocalizations of positive affect, regardless of the face/posture orientation, are included.
5. Fussy/cry-state-related expression	Any expression of negative affect, regardless of intensity.



# CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

## Appendix B

### Categories of Maternal Behavior during Mother-Infant Interaction

---

Maternal Behaviors	Description
<hr/>	
I. Gazing and Facial Behaviors	
(Face-to-Face)	
1. No gazing/facial behav.	No gazing or facial behavior addressed to the infant.
2. Observing the infant	The mother is not gazing at the infant's face, but at the infant's behavior or a part of her/his body; the infant may gaze elsewhere or at her face.
3. Gazing at the infant's face	Mother and infant are in face-to-face interaction; the mother is gazing at the infant's face without smiling or showing any facial action; the infant may gaze at the mother's face or elsewhere.
4. Smiling	Mother and infant are in face-to-face interaction or in possible visual contact; the mother is smiling at the infant's face; the infant may gaze (and smile) at the mother's face or elsewhere.
5. Facial stimulation	Mother and infant are in face-to-face interaction; the mother is trying to get the infant's attention with facial stimuli, as tongue protrusion or lip protrusion to mime kisses.
6. Facial mirroring	Mother and infant are in face-to-face interaction; the mother is repeating an infant's facial action (smile, brow raising, brow knitting, yawn) either by imitating it exactly or with particular emphasis, reproducing the affective quality of the infant action; the infant is gazing at her.
<hr/>	
II. Vocal Behaviors (Narrative Envelope)	
1. No vocal behavior	The mother does not express any vocal behavior.
2. Affectionate talking	The mother is talking to the infant in an affectionate way, expressing positive affect; she may use baby talk with emphasis on prosodic contours of the phrases, simple repeated words, but also long phrases. Laugh vocalizations interspersed with affectionate talking are included.
3. Rhythmic vocalizing	The mother is vocalizing to the baby in a rhythmic, repetitive and fast way (at least twice), expressing mild positive affect; she may use guttural sounds, some syllables, and one or some words. <i>Examples:</i> The mother is saying "gu-gu" repeatedly in a rhythmic way. The mother is telling repeatedly and fastly "dance for mummy" many times.
4. Singing	The mother is singing a popular baby song or strophes invented by her referred to the infant. <i>Example:</i> The mother is singing: "Obaapa is a good

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

girl, hia-hia-ho...”.

### 5. Vocal mirroring

The mother is repeating an infant’s vocal action (vocalization) either by imitating it exactly or with particular emphasis; she may also vocally reproduce the affective quality - i.e., rhythm, affective contour, intensity - of an infant’s body action (e.g., up and down arm movements). *Example:* During a face-to face protoconversation the mother is repeating the infant’s vocalization “*nghè*” reproducing its acoustic characteristics.

---

### III. Body Contact

#### 1. No body contact

No body contact between mother and infant. *Example:* The infant is lying on the infant-seat and the mother is in front of him.

#### 2. Moderate body contact

Any amount of body contact in between “No body contact” and “Whole body contact”. *Example:* The infant is sitting on mother’s legs and she is holding her hands.

#### 3. Whole body

The infant is held in mother’s arms, so that the infant’s legs, arms, head, back or chest are in physical contact with the mother’s body. *Example:* The mother is embracing the infant, who is sitting on her legs.

---

### IV. Body Stimulation

#### 1. No body stimulation

The mother may be in body contact or not with the infant, but she is not exerting any kind of movement on the infant’s body.

#### 2. Vestibular/motor

The mother is shaking or rocking back and forth the infant’s whole body, from side to side or up and down with one or more fast movements, and the infant’s position in space may change significantly. *Examples:* The mother is moving the infant to an upright position. The mother is rising up the infant by the hands.

#### 3. Rhythmic vestibular/motor

The vestibular or motor stimulation is rhythmically repeated (at least twice). *Example:* The mother is jumping the infant in a rhythmic way.

#### 4. Kinesthetic

The mother is moving one part of the infant’s body, e.g., arm/s or leg/s.

#### 5. Rhythmic kinesthetic

The kinesthetic stimulation is rhythmically repeated (at least two times). *Example:* The mother is moving the infant’s arms in a rhythmic way, reproducing the cycling activity.

#### 6. Tactile

The mother is touching the infant without moving any part of her body. *Example:* The mother is kissing or caressing the infant.

#### 7. Rhythmic tactile

The tactile stimulation is rhythmically repeated (at least twice). *Example:* The mother is patting repeatedly the infant’s back.

---

### V. Object Stimulation

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

- |                                  |   |
|----------------------------------|---|
| 1. No object stimulation         | No object included in mother-infant interaction.  |
| 2. Visual                        | The mother is getting the infant's attention by showing her an object.  |
| 3. Visual and auditory           | The mother is getting the infant's attention with both the sound and the visual presentation of an object. <i>Examples:</i> The mother is shaking a rattle while showing it to the infant.                      |
| 4. Tactile and visual            | The mother is touching a small part of the infant's body with an object, and the infant can see it. <i>Example:</i> The mother is putting a toy on the infant's hand.   |
| 5. Tactile, visual, and auditory | The mother is touching a little part of the infant's body with an object that makes a sound, and the infant can see it. <i>Example:</i> The mother is shaking a rattle on the infant's hand and she can see it. |

---

### VI. Primary Care

- |                    |   |
|--------------------|---|
| 1. No primary care | No caring routines.   |
| 2. Primary care    | The mother is involving the infant in caring routines, as dressing, cleaning his mouth or ears, oiling the skin, cutting nails, combing hair, giving medicine or water. <i>Example:</i> The mother is cleaning the infant's mouth with a bib. |
-

Table 1

*Maternal Behavioral Patterns during Mother-Infant Interaction in Different Sociocultural Contexts*

Behavioral Pattern	Description	Categories of Maternal Behavior (see Appendix B) that define each maternal behavioral pattern
Body Contact	The mother is in whole or moderate body contact with the infant, regardless of the possible co-presence of other behaviors.	Body Contact (2 = Moderate body contact OR 3 = Whole body contact)
Gazing	The mother is gazing at the infant without other forms of facial stimulation, regardless of the possible co-presence of other behaviors.	Gazing and Facial Behaviors (2 = Observing OR 3 = Gazing at the infant's face)
Affectionate Talking / Smiling	The mother is talking to the infant in an affectionate way and/or smiling at her, or mirroring infant's facial or vocal actions.	Gazing and Facial Behaviors (3 = Gazing at the infant's face OR 4 = Smiling OR 5 = Facial stimulation OR 6 = Facial mirroring) AND Vocal Behaviors (2 = Affectionate talking OR 5 = Vocal mirroring)
Motor Stimulation/ Rhythmic Vocalization	The mother is providing the infant with motor experience in the space (e.g., lifting the infant up and down, shaking, rocking back and forth), mostly in a rhythmic way accompanied by rhythmic vocalizing or singing; motor stimulation may be limited to a part of the infant's body (e.g., limb movements).	Gazing and Facial Behaviors (2 = Observing OR 3 = Gazing at the infant's face OR 4 = Smiling) AND Body Stimulation (2 = Vestibular/motor OR 3 = Rhythmic vestibular/motor OR 4 = Kinaesthetic OR 5 = Rhythmic kinaesthetic) AND Vocal Behaviors (3 = Rhythmic vocalizing OR 4 = Singing)
Tactile Stimulation	The mother is touching the infant in an affectionate way (kissing, caressing) while gazing or smiling at her; possible affectionate talking or rhythmic vocalizing.	Gazing and Facial Behaviors (2 = Observing OR 3 = Gazing at the infant's face OR 4 = Smiling) AND Body Stimulation (6 = Tactile OR 7 = Rhythmic tactile); possible Vocal Behaviors (2 = Affectionate talking OR 3 = Rhythmic vocalizing)
Object Stimulation	The mother is providing the infant with object stimulation, regardless of the possible co-presence of other behaviors.	Object Stimulation (2 = Visual OR 3 = Visual and auditory OR 4 = Tactile and visual OR 5 = Tactile, visual, and auditory).

CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

Table 2

*Duration (in Seconds) of Infants' Joint States of Gaze Direction and Emotional Expressions during Mother-Infant Interaction (300 s)*

Joint States	Italian	Immigrant	Nso	ANOVA <sup>a</sup>		
Infant age (weeks)	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>(df)F</i>	<i>p</i>	<i>η<sub>p</sub><sup>2</sup></i>
<b>Neutral Expression</b>						
<b>Gazing Environm/Ob</b>						
4 w	164 (53.9)	194 (63.7)	211 (53.7)	Age (4, 228) 0.00	<i>ns</i>	<i>ns</i>
6 w	56 (38.7)	96 (56.4)	146 (81.4)	Group (2, 57) 29.10	< .001	.51
8 w	19 (25.5)	71 (61.5)	91 (86.6)	AxG (8, 228) 0.75	<i>ns</i>	<i>ns</i>
10 w	19 (25.4)	43 (35.4)	85 (80.1)			
12 w	4 (6.3)	16 (21.0)	54 (81.9)			
<b>Active Attention</b>						
<b>Gazing Environm/Ob</b>						
4 w	41 (39.1)	24 (24.7)	44 (38.4)	Age <sup>b</sup> (3.32, 189.15) 0.00	<i>ns</i>	<i>ns</i>
6 w	47 (47.6)	95 (59.8)	78 (70.3)	Group (2, 57) 12.00	< .001	.30
8 w	54 (55.9)	112 (46.9)	158 (96.0)	AxG <sup>b</sup> (6.64, 189.15) 2.85	<i>ns</i>	<i>ns</i>
10 w	73 (63.5)	133 (51.4)	153 (81.9)			
12 w	96 (63.3)	170 (82.2)	183 (82.3)			
<b>Smiling/Cooing</b>						
<b>Gazing Environm/Ob</b>						
4 w	2 (7.3)	6 (4.3)	2 (5.2)	Age (4, 228) 0.00	<i>ns</i>	<i>ns</i>
6 w	14 (19.5)	14 (14.7)	24 (24.9)	Group (2, 57) 3.94	<i>ns</i>	<i>ns</i>
8 w	17 (15.4)	26 (27.0)	20 (16.6)	AxG (8, 228) 1.40	<i>ns</i>	<i>ns</i>
10 w	18 (10.4)	34 (29.6)	30 (27.9)			
12 w	18 (14.3)	20 (12.9)	36 (30.1)			
<b>Simple Att/Neutral</b>						
<b>to Mother's Face</b>						
4 w	46 (33.9)	40 (40.0)	26 (30.8)	Age (4, 228) 0.00	<i>ns</i>	<i>ns</i>
6 w	23 (25.4)	27 (31.5)	16 (15.7)	Group (2, 57) 2.82	<i>ns</i>	<i>ns</i>
8 w	6 (9.8)	6 (13.2)	3 (5.3)	AxG (8, 228) 0.42	<i>ns</i>	<i>ns</i>
10 w	6 (7.4)	3 (3.4)	4 (4.3)			
12 w	2 (2.4)	3 (3.8)	1 (1.8)			
<b>Active Attention</b>						
<b>to Mother's Face</b>						
4 w	41 (35.0)	30 (33.9)	17 (16.9)	Age (4, 228) 0.00	<i>ns</i>	<i>ns</i>
6 w	92 (53.6)	48 (42.3)	20 (14.6)	Group (2, 57) 38.10	< .001	.57
8 w	98 (60.7)	45 (47.9)	13 (17.7)	AxG (8, 228) 1.36	<i>ns</i>	<i>ns</i>
10 w	80 (38.6)	46 (38.9)	14 (12.6)			
12 w	94 (45.2)	51 (50.3)	11 (11.1)			
<b>Smiling/Cooing</b>						
<b>at Mother's Face</b>						
4 w	6 (10.8)	6 (10.0)	0 (0)	Age (4, 228) 0.00	<i>ns</i>	<i>ns</i>
6 w	68 (53.6)	20 (27.6)	16 (19.6)	Group (2, 57) 45.4	< .001	.61
8 w	106 (51.4)	40 (43.1)	15 (13.4)	AxG (8, 228) 3.58	< .001	.11
10 w	104 (59.3)	41 (28.3)	14 (18.5)			
12 w	86 (44.6)	40 (34.9)	15 (13.1)			

Note. All significant results have power (1-β) = 1.

<sup>a</sup> ANOVA was performed on ranked data. <sup>b</sup> Greenhouse-Geisser's F.

CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

Table 3

*Duration (in Seconds) of Body Contact and Maternal Behavioral Patterns during Mother-Infant Interaction (300 s)*

Behavioral Pattern	Italian	Immigrant	Nso	ANOVA <sup>a</sup>		
Infant age (weeks)	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>(df)F</i>	<i>p</i>	$\eta_p^2$
<b>Body Contact</b>						
4 w	224 (92.1)	276 (20.7)	288 (27.4)	Age (4, 228) 0.00	<i>ns</i>	<i>ns</i>
6 w	106 (122.6)	277 (46.3)	288 (43.2)	Group (2, 57) 50.30	< .001	.64
8 w	72 (120.9)	269 (71.6)	292 (24.0)	AxG (8, 228) 3.71	< .001	.12
10 w	60 (98.5)	226 (100.5)	288 (35.3)			
12 w	73 (120.0)	278 (36.3)	285 (23.4)			
<b>Gazing</b>						
4 w	178 (58.5)	119 (59.4)	102 (85.4)	Age <sup>b</sup> (3.07, 174.95) 1.38	<i>ns</i>	<i>ns</i>
6 w	140 (56.0)	104 (72.1)	79 (79.3)	Group (2, 57) 17.20	< .001	.38
8 w	138 (56.8)	93 (55.9)	76 (83.4)	AxGb (6.14, 174.95) 1.68	<i>ns</i>	<i>ns</i>
10 w	125 (52.0)	105 (66.7)	61 (82.7)			
12 w	99 (63.3)	65 (58.9)	57 (76.3)			
<b>Affectionate Talking/ Smiling</b>						
4 w	153 (57.1)	124 (61.8)	69 (65.8)	Age (4, 228) 4.09	.003	.07
6 w	223 (37.8)	125 (64.6)	79 (65.4)	Group (2, 57) 53.70	< .001	.66
8 w	229 (44.0)	140 (82.2)	64 (58.1)	AxG (8, 228) 1.66	<i>ns</i>	<i>ns</i>
10 w	235 (35.5)	137 (56.6)	63 (57.9)			
12 w	253 (22.7)	169 (77.0)	61 (52.8)			
<b>Motor Stimulation/ Rhythmic Vocalizing</b>						
4 w	74 (73.2)	156 (41.4)	177 (73.9)	Age <sup>b</sup> (3.05, 173.63) 0.00	<i>ns</i>	<i>ns</i>
6 w	52 (49.8)	160 (70.1)	182 (66.4)	Group (2, 57) 54.40	< .001	.66
8 w	52 (48.0)	166 (67.9)	187 (47.9)	AxG <sup>b</sup> (6.09, 173.63) 1.08	<i>ns</i>	<i>ns</i>
10 w	43 (29.9)	147 (75.2)	178 (73.3)			
12 w	47 (28.6)	154 (75.1)	183 (63.2)			
<b>Tactile Stimulation</b>						
4 w	111 (72.6)	61 (47.7)	28 (35.5)	Age <sup>b</sup> (3.05, 173.66) 0.00	<i>ns</i>	<i>ns</i>
6 w	95 (68.79)	61 (29.6)	44 (48.4)	Group (2, 57) 22.40	< .001	.44
8 w	95 (64.1)	50 (36.3)	46 (43.7)	AxG <sup>b</sup> (6.09, 173.66) 12.00	< .001	.30
10 w	76 (69.9)	43 (27.7)	37 (37.6)			
12 w	57 (37.6)	44 (30.6)	50 (40.7)			
<b>Object Stimulation</b>						
4 w	23 (52.7)	3 (6.3)	4 (19.5)	Age (4, 228) 0.00	<i>ns</i>	<i>ns</i>
6 w	21 (53.3)	4 (11.4)	0 (0.0)	Group (2, 57) 17.00	< .001	.37
8 w	38 (80.6)	2 (6.8)	0 (0.0)	AxG (8, 228) 0.77	<i>ns</i>	<i>ns</i>
10 w	68 (86.9)	31 (69.2)	8 (34.6)			
12 w	50 (78.9)	10 (30.2)	10 (33.3)			

Note. All significant results have power  $(1-\beta) = 1$ .

<sup>a</sup> ANOVA was performed on ranked data. <sup>b</sup> Greenhouse-Geisser's F.

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

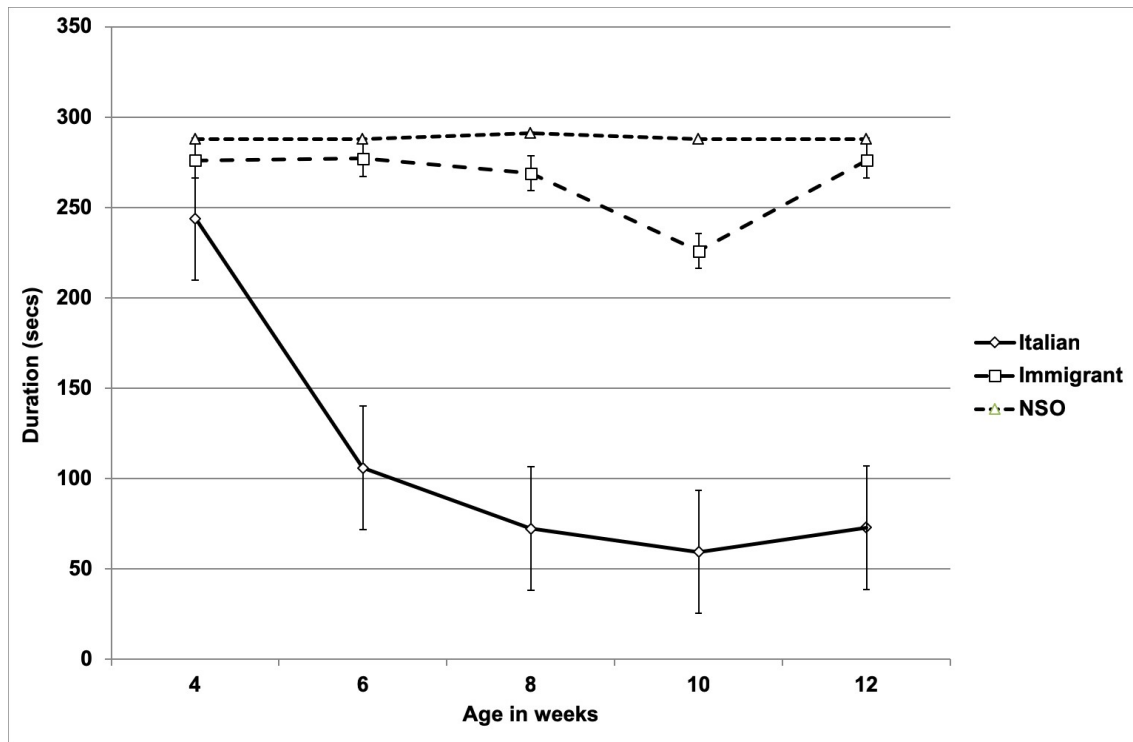


Figure 1. Durations of infant Smiling and/or Cooing at the mother's face.

## CULTURE-SPECIFIC DEVELOPMENT OF EMOTIONAL CO-REGULATION

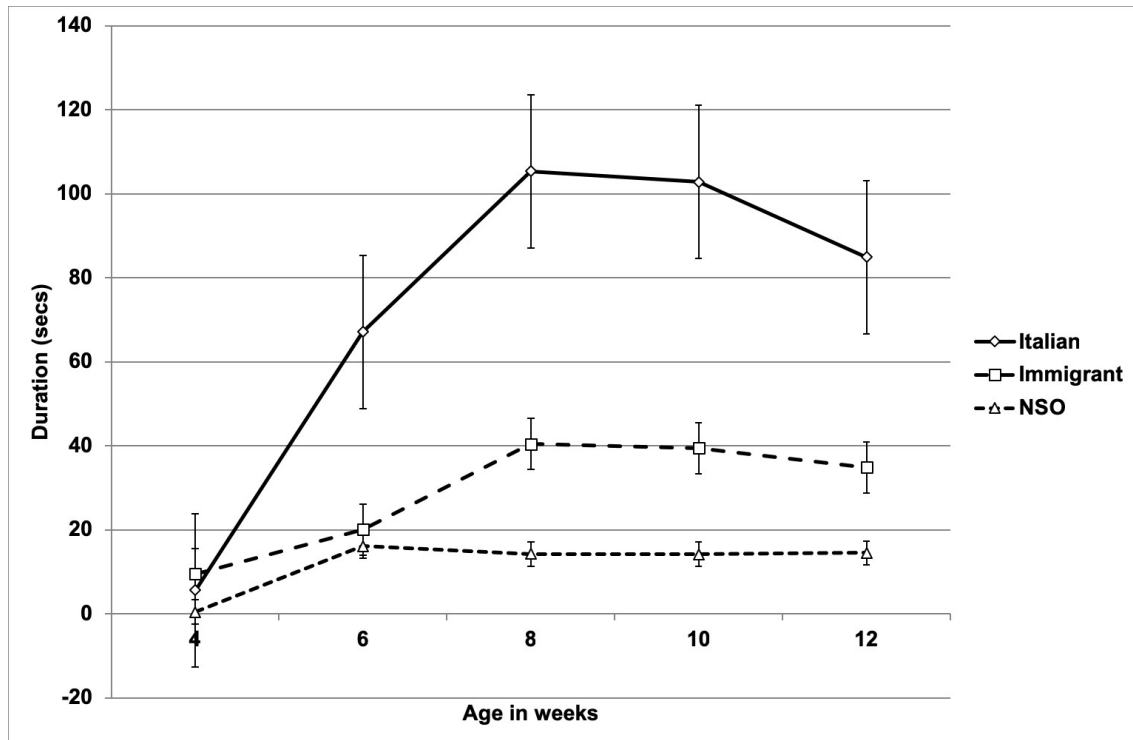


Figure 2. Durations of mother-infant Body Contact.



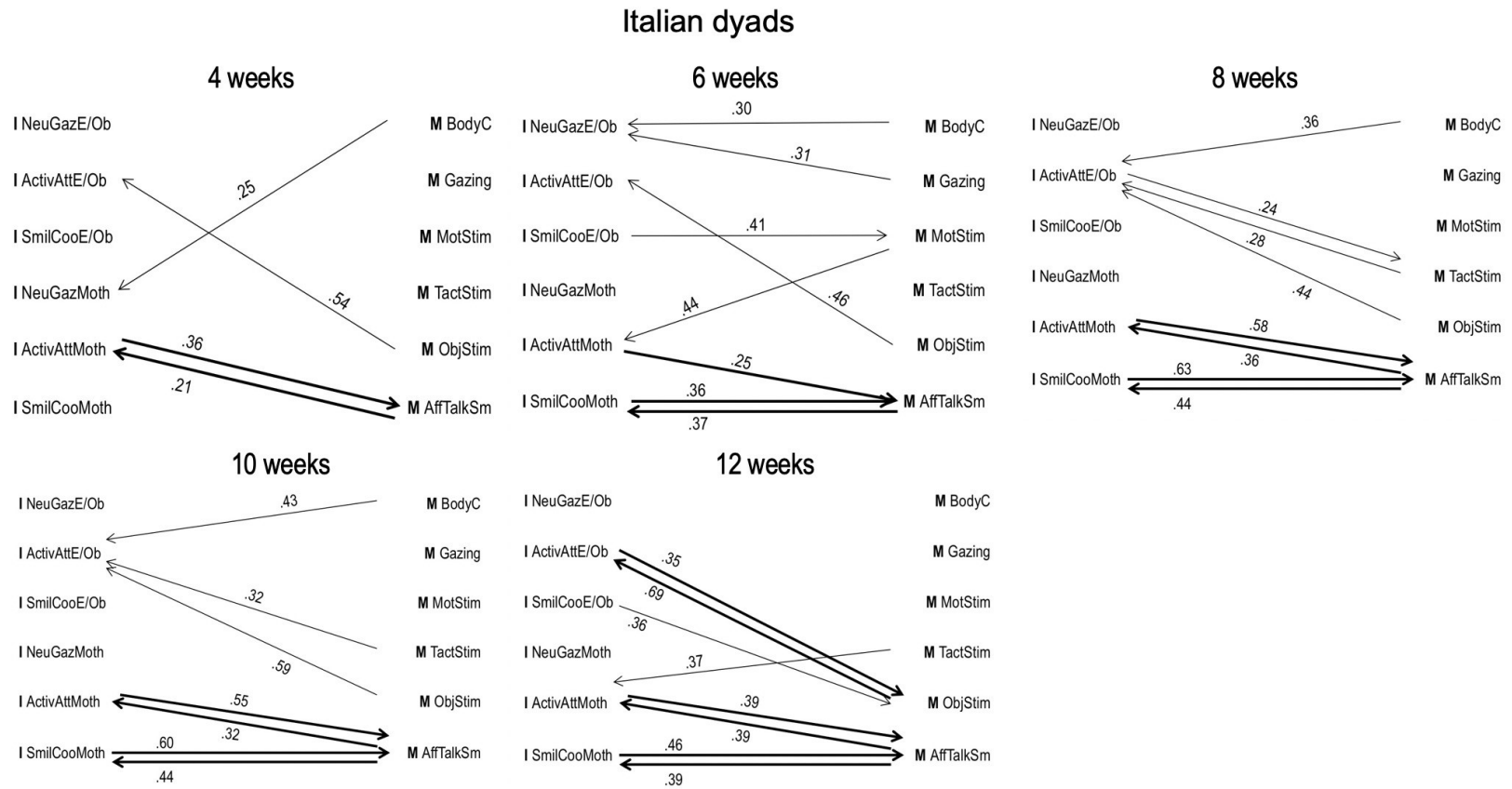


Figure 3. Mean transitional probabilities between maternal and infant's behaviors during mother-infant interaction in Italian dyads. Only transitional probabilities associated with statistically significant adjusted residuals are included. I = infant; NeuGazE/Ob = Neutral expression Gazing Elsewhere/Object; ActivAttE/Ob = Active Attention Gazing Elsewhere/Object; SmilCooE/Ob = Smiling and/or Cooing Gazing Elsewhere/Object; NeuGazMoth = Neutral expression Gazing at Mother's face; ActivAttMoth = Active Attention to Mother's face; SmilCooMoth = Smiling and/or Cooing at Mother's face; M = mother; BodyC = Body Contact; Gazing = Gazing at infant; MotStim = Motor Stimulation with/without Rhythmic Vocalizing; TactStim = Tactile Stimulation; ObjStim = Object Stimulation; AffTalkSm = Affectionate Talking and/or Smiling.

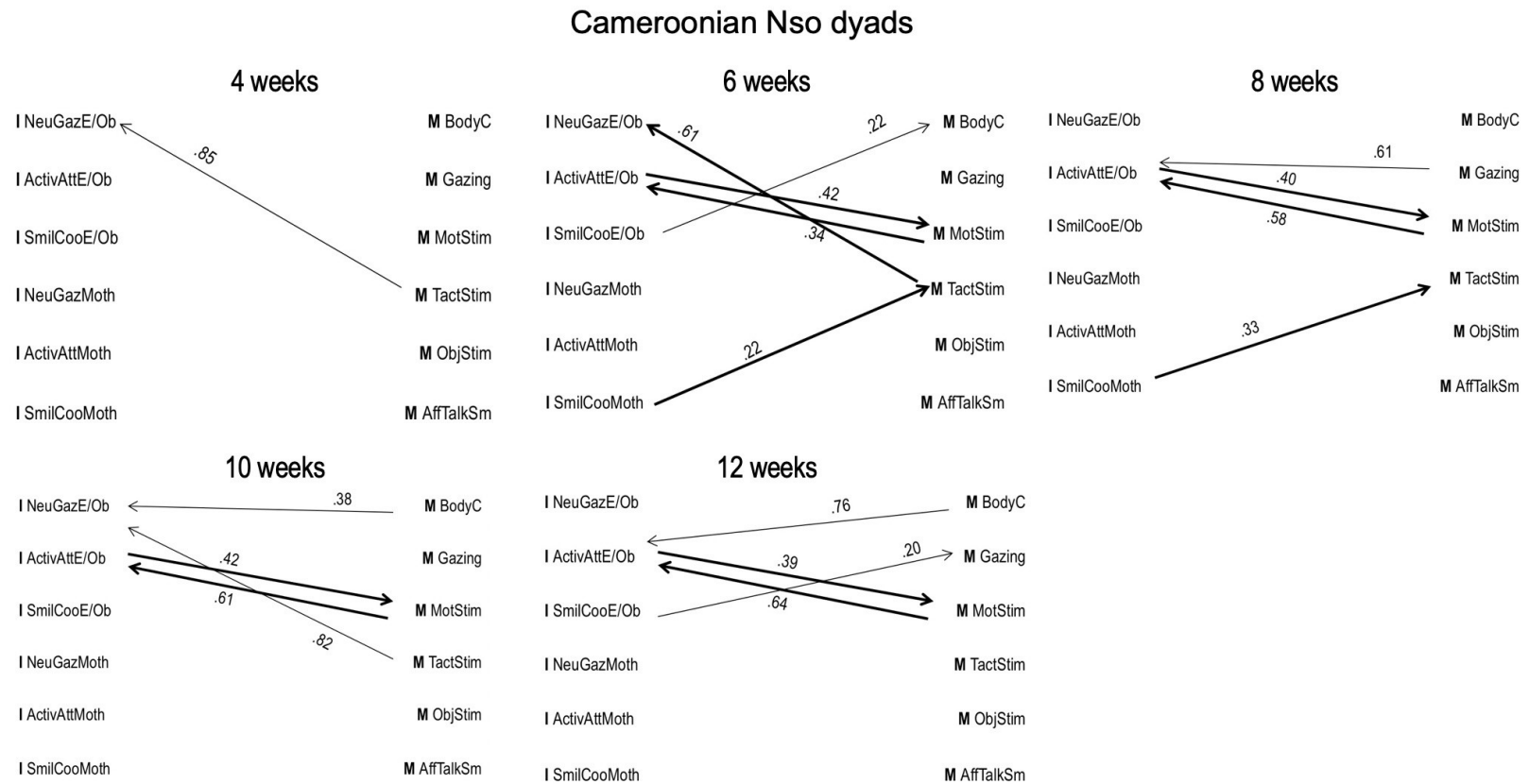


Figure 4. Mean transitional probabilities between maternal and infant's behaviors during mother-infant interaction in Cameroonian Nso dyads. Only transitional probabilities associated with statistically significant adjusted residuals are included. I = infant; NeuGazE/Ob = Neutral expression Gazing Elsewhere/Object; ActivAttE/Ob = Active Attention Gazing Elsewhere/Object; SmilCooE/Ob = Smiling and/or Cooing Gazing Elsewhere/Object; NeuGazMoth = Neutral expression Gazing at Mother's face; ActivAttMoth = Active Attention to Mother's face; SmilCooMoth = Smiling and/or Cooing at Mother's face; M = mother; BodyC = Body Contact; Gazing = Gazing at infant; MotStim = Motor Stimulation with/without Rhythmic Vocalizing; TactStim = Tactile Stimulation; ObjStim = Object Stimulation; AffTalkSm = Affectionate Talking and/or Smiling.

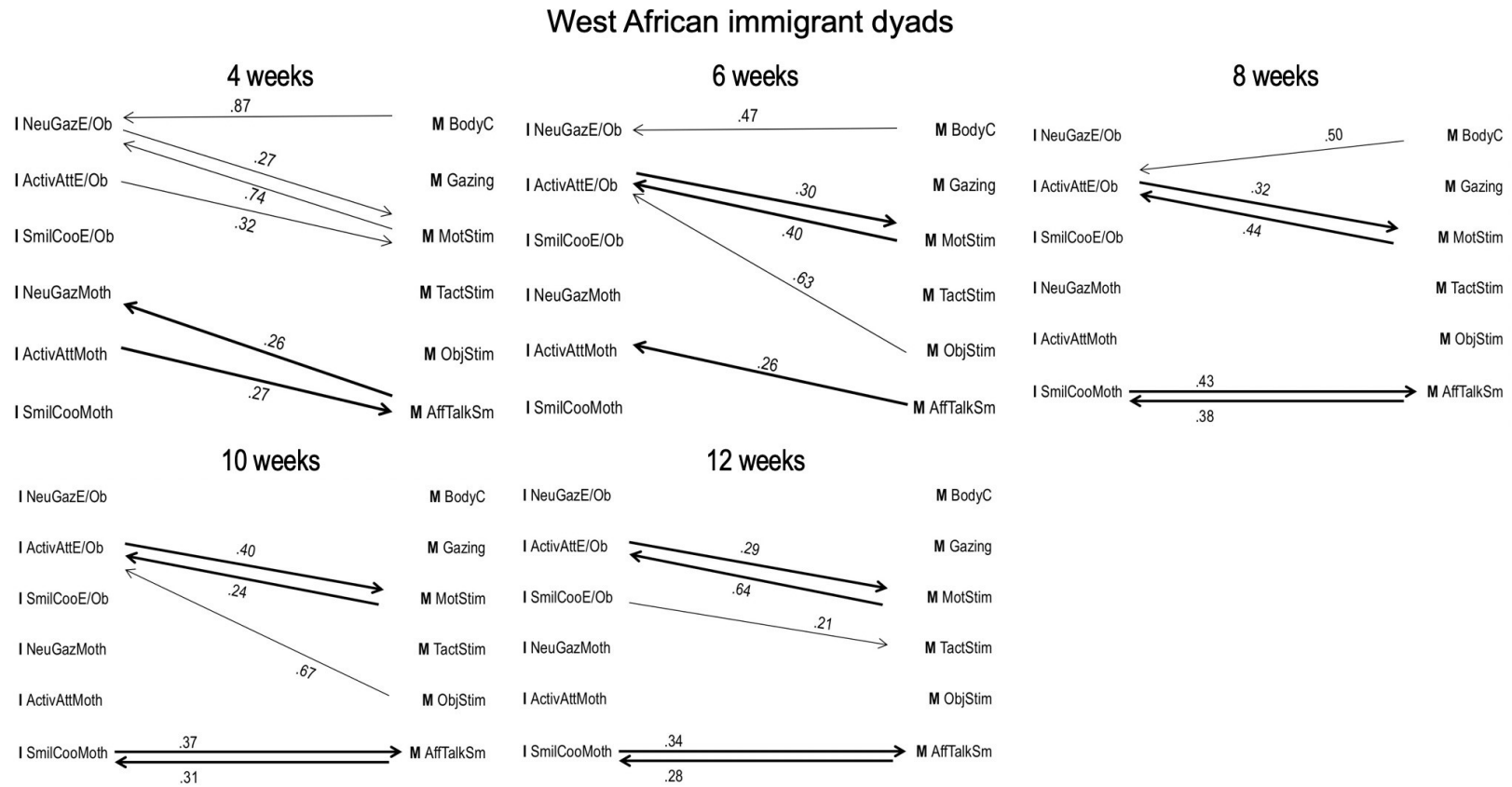


Figure 5. Mean transitional probabilities between maternal and infant's behaviors during mother-infant interaction in West African immigrant dyads. Only transitional probabilities associated with statistically significant adjusted residuals are included. I = infant; NeuGazE/Ob = Neutral expression Gazing Elsewhere/Object; ActivAttE/Ob = Active Attention Gazing Elsewhere/Object; SmilCooE/Ob = Smiling and/or Cooing Gazing Elsewhere/Object; NeuGazMoth = Neutral expression Gazing at Mother's face; ActivAttMoth = Active Attention to Mother's face; SmilCooMoth = Smiling and/or Cooing at Mother's face; M = mother; BodyC = Body Contact; Gazing = Gazing at infant; MotStim = Motor Stimulation with/without Rhythmic Vocalizing; TactStim = Tactile Stimulation; ObjStim = Object Stimulation; AffTalkSmSm = Affectionate Talking and/or Smiling.