

The still-face response in newborn, 1.5-, and 3-month-old infants

Evelin Bertin^{a,*}, Tricia Striano^{b,c,d}

^a *University of Zürich, Department of Psychology, Cognitive and Developmental Psychology, Attenhoferstrasse 9, 8032 Zürich, Switzerland*

^b *Max-Planck Institute for Human Cognitive and Brain Sciences, Neurocognition & Development, Germany*

^c *University of Leipzig, Center for Advanced Studies, Neurocognition and Development, Germany*

^d *Vanderbilt University, Department of Pediatrics and Kennedy Center for Human Development, United States of America*

Received 9 August 2005; received in revised form 30 November 2005; accepted 30 December 2005

Abstract

The present study investigated the still-face response to a female stranger in newborn, 1.5-, and 3-month-old infants. The results revealed that 1.5- and 3-month-olds, but not newborns, reliably decreased their visual attention and positive affect when the interaction partner became unresponsive during the still-face period.

© 2006 Elsevier Inc. All rights reserved.

Keywords: Still-face; Gazing; Smiling; Social interaction; Newborns

Humans are born with a readiness to communicate and connect with other people. Shortly after birth, infants prefer human stimuli such as face-like compared to non-face-like patterns and human over non-human sounds (e.g., Friedlander, 1970; Johnson, Dziurawiec, Ellis, & Morton, 1991). Moreover, very young infants imitate facial gestures and emotional expressions (e.g., Field, Woodson, Greenberg, & Cohen, 1983; Meltzoff & Moore, 1989), which has been explained both in terms of perceptual cross-modal matching and the fundamental need for interpersonal communication (Trevorthen, 1993). These findings suggest an early sensitivity to social stimuli and a readiness for interpersonal contact.

Newborns' draw to social stimuli provides the necessary basis for acquiring knowledge about the nature of interpersonal interactions. One of the most robust procedures to test infants' understanding of natural interaction patterns is the still-face (SF) paradigm (Tronick, Als, Adamson, Wise, & Brazelton, 1978). In this paradigm, a normal face-to-face interaction between an infant and an adult is interspersed with a period in which the adult suddenly freezes, becomes unresponsive, and poses a stationary neutral face while maintaining eye contact. Infants as young as 2 months of age react to the adults' unresponsiveness during the SF period with decreased visual attention and positive affect (e.g., Lamb, Morrison, & Malkin, 1987; Tronick et al., 1978). Such results are interpreted in terms of infants' affective attunement to social patterns and rudimentary expectations about the nature of face-to-face interactions (e.g., Muir & Hains, 1993).

The majority of studies examined the SF response in infants between the age of 2 and 9 months (see Adamson & Frick, 2003). Therefore, the question of whether, and to what extent, younger infants respond to perturbed adult

* Corresponding author. Tel.: +41 44 634 2894; fax: +41 44 634 4929.
E-mail address: e.bertin@psychologie.unizh.ch (E. Bertin).

interactive behavior remains. In the current study, we investigated the development of the SF effect in the first months of infancy. There are at least two reasons why infants younger than 2 months might exhibit the SF response. First, the SF paradigm is characterized by many perceptual differences between the interactive and SF period. It is plausible that even newborn infants, who possess many perceptual capabilities (e.g., Slater, 1997, for a review), are sensitive to these changes. Second, given the prevalence and importance of responsive and reciprocative face-to-face interactions in Western cultures (e.g., Bornstein, Azuma, Tamis-LeMonda, & Ogino, 1990), a rudimentary understanding of the nature of dyadic interactions might form rapidly and be in place even before 2 months of age. By testing newborns, we were able to examine whether the SF response mainly rests upon postnatal development and social experiences or if it perhaps is innate.

Although the typical response to a still-face manifests itself in both gaze and smile, it is possible that in young infants one of the signature behaviors prevails over the other. By observing infants in the SF paradigm before and at 3 months of age, we were able to examine if the SF response progresses from mainly visual attentive in younger infants to both visual and affective in older infants, or whether the signature responses always occur together.

Eighteen newborns (9 females, 9 males; $M = 3.67$ days, $S.E. = 0.36$), eighteen 1.5-month-olds (10 females, 8 males; $M = 46.61$ days, $S.E. = 1.24$), and eighteen 3-month-olds (7 females, 11 males; $M = 95.44$ days, $S.E. = 2.08$) participated in this experiment. An additional 20 infants (eleven newborns, seven 1.5-month-olds, and two 3-month-olds) were tested but not included in the study because of fussiness ($n = 10$; six newborns, three 1.5-month-olds, and one 3-month-old), sleepiness ($n = 9$; five newborns, four 1.5-month-olds), and parental interference ($n = 1$; 3-month-old). All participants were healthy and full-term, and recruited from a city hospital of a mid-size Germany town.

Newborns were tested in a quiet room at the hospital at a time when they were alert (i.e., eyes open and attention directed toward external stimuli) usually midway between morning feedings. 1.5- and 3-month-olds were tested in a laboratory room at the research institute. Infants were seated in an infant seat (reclined 30°). A female experimenter (E1) stood bent forward in front of the infant to allow face-to-face interaction. E1 engaged with each infant in a 180-s interaction episode that was divided into three consecutive 60-s periods. Testing always began and ended with a 60-s normal interaction period (N1 and N2, respectively) in which the experimenter smiled, vocalized, and responded to any communicative overture infants exhibited. The normal interaction periods were separated by a 60-s SF period in which the experimenter posed a stationary, silent still-face with neutral expression while maintaining eye contact. E1 did not touch the infant throughout the entire 180-s interaction episode. The experimental sessions were video recorded.

For each 60-s interaction period, the duration of infants' *Gazing* and *Smiling* was coded from video tapes by an observer who was blind to the hypotheses of the study. Duration scores were converted into percent durations. *Gazing* was defined as any looks to the experimenter's face. *Smiling* was defined as cheeks raised and at least one corner of the mouth turned up while gazing. Inter-rater reliability was computed on 18 participants yielding Cohen's kappa .94 for gazing and .91 for smiling.

An age group (*newborns, 1.5-month-olds, 3-month-olds*) \times period (N1, SF, N2) mixed design ANOVA for *Gazing* yielded an age group main effect, $F(2,51) = 7.46$, $p < .01$. Least significant difference (L.S.D.) pair-wise comparisons indicated that newborns gazed significantly less at E1 than both 1.5- and 3-month-old infants. A main effect for period was also observed, $F(2,102) = 9.74$, $p < .001$, with L.S.D.s pointing to a significant decrease in looking toward E1 during the SF than both the N1 and N2 period. One-way ANOVAs revealed that, while infants did not differ in gazing duration in the SF period ($p > .05$), newborns spent significantly less time looking at E1 than 1.5- and 3-month-olds in the both normal interaction periods (all $ps < .03$). No other comparisons reached significance (Fig. 1).

One-way repeated measures ANOVAs revealed no quadratic trends for newborns' gazing pattern, $F(1,17) = 1.97$, $p > .1$. However, the decrease in looking at E1 from N1 to the SF period reached marginal significance ($p = .077$). The looking pattern of both 1.5- and 3-month-olds was defined by a significant quadratic effect ($F(1,17) = 12.25$, $p < .01$; $F(1,17) = 17.99$, $p < .01$, respectively). Specifically, while 3-month-olds gazed at E1 significantly less in the still-face compared to both normal interaction periods ($ps < .005$), 1.5-month-olds significantly decreased their looking only from the first normal to the SF period ($p < .005$).

The age group (*newborns, 1.5-month-olds, 3-month-olds*) \times period (N1, SF, N2) mixed design ANOVA for *Smiling* yielded significant main effects for age group ($F(2,51) = 4.94$, $p < .02$) and period ($F(2,102) = 9.95$, $p < .001$). Follow-up L.S.D.s revealed that newborns smiled significantly less than both 1.5- and 3-month-olds ($ps < .02$), and that infants smiled more in the normal interaction periods than in the SF period ($ps < .03$). The interaction effect also reached significance ($F(4,102) = 2.55$, $p < .05$). The one-way ANOVAs for *Smiling* revealed the same pattern as for *Gazing*, in that infants' duration of smiling did not differ during the SF period ($p > .05$), but was significantly less for newborns

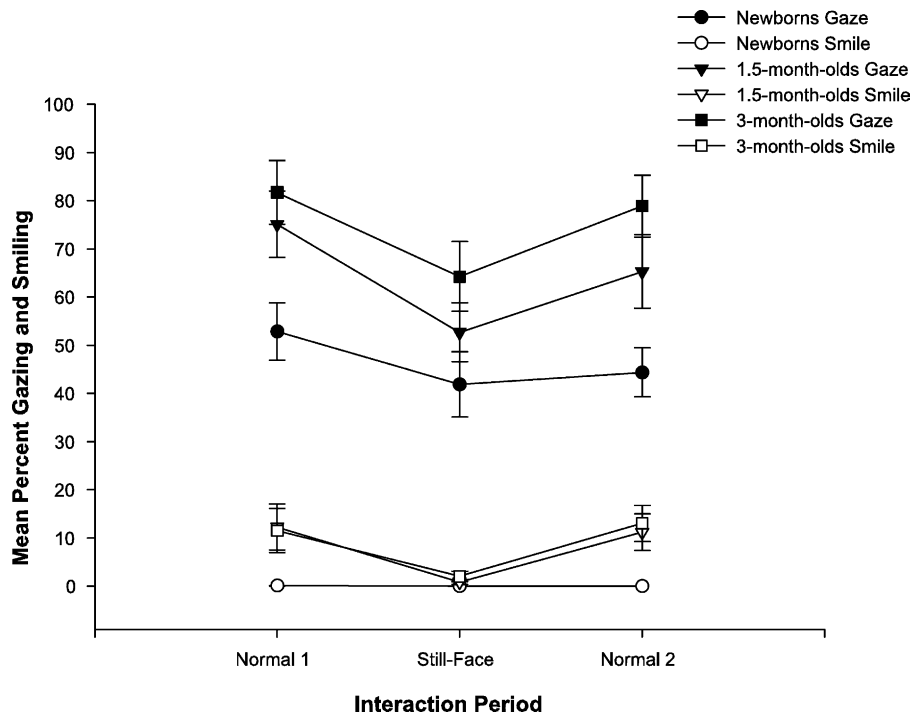


Fig. 1. Mean percent duration of Gazing and Smiling as a function of interaction period and group.

than both older age groups during N1 and N2 ($ps < .05$). The quadratic trends of *Smiling* were significant for both older age groups (1.5-month-olds: $F(1,17) = 8.43, p < .03$; 3-month-olds: $F(1,17) = 8.38, p < .02$), but not for newborns ($F(1,17) = 1.0, p > .1$). The quadratic trends for 1.5- and 3-month-olds revealed that infants smiled at E1 significantly less in the SF compared to both normal interaction periods ($ps < .05$) (Fig. 1).

While the SF effect was similarly observed in 1.5- and 3-month-olds, newborns—despite their perceptual abilities across modalities and their predisposed sensitivity to social stimuli—did not reliably change their behavior relative to the interaction periods. Although gaze patterns are qualitatively similar for all age groups (see Fig. 1), the data point to age-related differences in the visual response to perturbations in natural interaction patterns. For example, newborns' drop in visual attention from N1 to SF was only tendential while it was significant for 1.5- and 3-month-olds. Only 3-month-olds showed the effect-typical increase in visual attention during the re-engagement period, while both newborns' and 1.5-month-olds' recovery from SF to N2 was insignificant. Moreover, 1.5- and 3-month-olds accompanied their visual attentive behavior with positive affect. Thus, while similarities in the patterns of the SF responses were observed, the data seem to suggest that infants' reactions to social perturbations grow more robust between the age of 0 and 3 months. Contrary to our assumption, we did not find that the SF effect progresses from mainly visual attentive in younger infants to both visual and affective in older infants.

In a study with 2-day-olds, Ellsworth (1987, cited in Muir & Hains, 1993) found that, as in the current study, newborns' visual attention was high in N1, abated in the SF period, and more or less plateaued when the female stranger resumed responsiveness. Moreover, Ellsworth's newborns also failed to exhibit affect during any interaction period. While some emotional expressive patterns can be present at birth (e.g., Galati & Lavelli, 1997), the short 3-min observation period, the overall similarity between the interaction periods (only vocal sound and corresponding facial movement ceased during SF), or the general difficulties inherent in measuring and interpreting newborns' emotions might have impeded the observation of newborns' emotional expressions in the current study.

While previous research has also revealed robust SF responses in 3-month-olds (e.g., Ellsworth, Muir, & Hains, 1993; Toda & Fogel, 1993), systematic investigations with younger infants have been scarce. In the current study, we measured only the signature SF behaviors of gazing and smiling (see also, Rochat, Striano, & Blatt, 2002). Employing this procedure, we did not find a strong SF effect in newborns. Newborns might be sensitive to the differences between a responsive and an unengaged social vis-à-vis, but simply lack the expressive repertoire to reveal their knowledge.

Maturation and continuous visual attention to social partners might lead to more mature SF responses. Thus, the observed behavioral patterns of newborns might constitute the precursor for such behavior.

Acknowledgments

We would like to thank Kerstin Träger, Caterina Böttcher, Wenke Möhring, and Andrea Kobiella for data collection and coding as well as the parents and infants for their participation in this study. The study was funded in part by the Sofja Kovelevskaja Prize of the Alexander von Humboldt Foundation to Tricia Striano. A fuller report of this study will be provided upon request.

References

- Adamson, L. B., & Frick, J. E. (2003). The still face: A history of a shared experimental paradigm. *Infancy*, 4(4), 451–473.
- Bornstein, M. H., Azuma, H., Tamis-LeMonda, C. S., & Ogino, M. (1990). Mother and infant activity and interaction in Japan and in the United States: A comparative macroanalysis of naturalistic exchange. *International Journal of Behavioral Development*, 13, 267–287.
- Ellsworth, C. P. (1987). *Person-object differentiation by young infants: The importance of affect measures in evaluation of social competence*. Unpublished Doctoral Dissertation. Queens University, Kingston, Canada.
- Ellsworth, C. P., Muir, D. W., & Hains, S. M. J. (1993). Social competence and person-object differentiation: An analysis of the still-face effect. *Developmental Psychology*, 29, 63–73.
- Field, T. M., Woodson, R., Greenberg, R., & Cohen, D. (1983). Discrimination and imitation of facial expression by neonates. *Science*, 218, 179–181.
- Friedlander, B. Z. (1970). Receptive language development in infancy. *Merrill-Palmer Quarterly*, 16, 7–51.
- Galanti, D., & Lavelli, M. (1997). Neonate and infant emotion expression perceived by adults. *Journal of Nonverbal Behavior*, 21, 57–83.
- Johnson, M. H., Dziurawiec, S., Ellis, H., & Morton, J. (1991). Newborns' preferential tracking for face-like stimuli and its subsequent decline. *Cognition*, 40, 1–19.
- Lamb, M., Morrison, D. C., & Malkin, C. M. (1987). The development of infant social expectations in face-to-face interaction: A longitudinal study. *Merrill-Palmer Quarterly*, 33, 241–254.
- Meltzoff, A. N., & Moore, M. K. (1989). Imitation in newborn infants: Exploring the range of gestures imitated and the underlying mechanisms. *Developmental Psychology*, 25, 954–962.
- Muir, D. W., & Hains, S. M. J. (1993). Infant sensitivity to perturbations in adult facial, vocal, tactile, and contingent stimulation during face-to-face interactions. In B. de Boyssons-Bardies & S. de Schonen (Eds.), *Developmental neurocognition: Speech and face processing in the first year of life* (pp. 171–183). Amsterdam: Elsevier.
- Rochat, R., Striano, T., & Blatt, L. (2002). Differential effect of happy, neutral, and sad still-faces on 2-, 4- and 6-month-old infants. *Infant and Child Development*, 11, 289–303.
- Slater, A. (1997). Visual Perception and its organization in early infancy. In G. Bremner, A. Slater, & G. Butterworth (Eds.), *Infant development: Recent advances* (pp. 31–53). East Sussex, UK: Psychology Press.
- Toda, S., & Fogel, A. (1993). Infant response to the still-face situation at 3 and 6 month. *Developmental Psychology*, 29, 532–538.
- Trevarthen, C. (1993). The function of emotions in early infant communication and development. In J. Nadel & L. Camioni (Eds.), *New perspectives in early communicative development* (pp. 23–47). London/New York: Routledge.
- Tronick, E., Als, H., Adamson, L., Wise, S., & Brazelton, T. B. (1978). The infant's response to entrapment between contradictory messages in face-to face interaction. *Journal of the American Academy of Child Psychiatry*, 17, 1–13.