COGNITION AND EMOTION
2005, 19 (5), 781–790

Psychology Press
Taylor & Francis Group

BRIEF REPORT

Coordinated affect with mothers and strangers: A longitudinal analysis of joint engagement between 5 and 9 months of age

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The coordination of affect in joint attention was assessed in a longitudinal study of 5- to 9-month-old infants as they interacted with mothers and strangers. Results showed that the coordination of affect with joint attention looks increased reliably with age. In addition, context effects were found such that joint attention looks increased while interacting with strangers but not with mothers. The study demonstrates the emergence of joint engagement before the end of the first year, and suggests that affect may play a key role in aspects of joint attention that may be unique to humans.

Joint engagement is considered a crucial part of human cognition, essential for skills such as language and theory of mind (e.g., Farroni, Mansfield, Lai, & Johnson, 2003). Although a wide range of species coordinate gaze between conspecifics and things (see Emery, 2000), in no other species is the inclination to share affect and to communicate about things by showing and offering them and by engaging in joint attention behaviour as strong as it is in humans (e.g., Tomasello, 1999). Given its potential role in human cognition, many questions have been asked about the development and function of joint engagement.

In a longitudinal study that considered the interrelationship of social-cognitive skills at monthly intervals between 9 and 15 months of age, Carpenter, Nagell, and Tomasello

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We thank the parents and the infants who participated in this study, Caterina Böttcher, Kerstin Träger for collecting data, and the Universitätsfrauenklinik Leipzig for support and assistance in subject recruitment.

http://www.tandf.co.uk/journals/pp/02699931.html DOI:10.1080/02699930541000002

(1998) reported the onset of joint engagement at 9 months of age. In one descriptive study on joint engagement before the end of the first year, Trevarthen and Hubley (1978) reported on one infant's interactions with her mother and objects. Whereas the infant showed interest to both objects and her mother in the early months, there was little evidence of coordinating attention between the objects and her mother until the end of the first year (see also Saxon, Frick, & Columbo, 1997). Interestingly, the infant also began to exchange smiles with her mother while playing at this age.

Bakeman and Adamson (1984) observed infants between 6 and 18 months of age while playing in the home with their mother or a peer. Coordinated joint engagement increased with age in both the mother-infant and the peer-infant play sessions. At all ages, infants were much more likely to coordinate attention when playing with mothers than with peers. These findings suggest that caregivers effectively scaffold infants' joint engagement in ways that peers do not. This may be due to the infant peers' less expansive behavioural repertoire. An alternative explanation, however, is that the higher frequency of joint engagement with the mother might reflect an inclination to share attention with a more familiar social partner, and that mothers are simply more familiar to infants than are peers. Observed differences in the frequency of joint engagement toward familiar versus less familiar social partners could help to assess the function of joint engagement. For instance, if joint engagement merely reflects learning or developing attention (e.g., Corkum & Moore, 1995) we might expect the same frequency of this skill regardless of the familiarity of the interacting social partner. This is most likely not the case, given that research with young infants suggests that familiarity of the social partner affects social responding.

Bigelow (1998) tested 4 to 5-month-olds' sensitivity to the contingent responsiveness of their mother versus a stranger during a face-to-face interaction. The authors found that infants vocalised and smiled more to a stranger whose level of contingent responsiveness was similar to that of their own mother (see also Bigelow & Birch, 1999). In a study assessing 5-month-olds' sensitivity to maternal contingency, Hains and Muir (1996) found that compared to interactions with strangers, infants tended to accept brief bouts of noncontingent behaviour from their mothers, presumably because they were more familiar with her interactive style. Furthermore, 4-month-old infants engage in more vocal coordination with strangers than with their mothers when interacting in the laboratory (i.e., Jaffee, Beebe, Feldstein, Crown, & Jasnow, 2001) which suggests that young infants may be more inclined to coordinate attention with strangers.

While the ability to engage in triadic interactions is not unique to humans, the sharing of affect during these episodes may be unique. Bakeman and Adamson (1984) defined joint engagement as ''the infant is actively involved with and coordinates his or her attention to both another person and the object the person is involved with'' (p. 1281). Carpenter and colleagues (1998) used a similar definition, but neither considered positive affect accompanied by coordination of gaze. It is surprising that affect has not been considered in recent studies of joint attention—given that affect seems to be the element that makes engagement joint—and more than the mere coordination of visual attention which so many species do.

Studies by Mundy, Kasari, and Sigman (1992) are an exception. They reported that 20-month-old infants systematically displayed more positive affect (smiling) when engaged in joint attention behaviours (e.g., showing objects) than when engaged in requesting behaviour (e.g., pointing to objects). The authors concluded that a critical

difference between joint attention skills and requesting skills may lie in the production of affect (see also Mundy, 1995). A study by Adamson and Bakeman (1985) assessed the relationship between positive affect and attention during object play with mothers and with peers. Starting at 9 months of age affective expressions were reliably more likely to occur when infants were in coordinated joint engagement with their mothers than with their peers. Affect was also observed in episodes of passive joint engagement with mothers (i.e., noncoordinated). These observations led the authors to conclude that ''joint engagement is *not* simply an alternation of periods of object play and period of person play with affect timed to coincide with moments of the latter'' (p. 591).

The current study assessed the coordination of smiling with visual joint engagement production in a group of 5- to 9-month-old infants observed on a longitudinal basis. This investigation is the first large-scale study to assess joint engagement before the end of the first year. Assessing the development of joint engagement before 9 months of age is critical given that those studies that suggest joint engagement begins at 9 months of age, did not consider developmental patterns *before* that age period (see Carpenter et al., 1998). The study is also unique in its consideration of affect and joint engagement together. These two domains have never been systematically studied in a longitudinal investigation. Assessing how these skills co-emerge is critical in establishing if affect plays a unique role in human joint attention.

METHOD

Participants

A total of 77 infants participated in the study. Eight infants were excluded due to fussiness in at least one session ($n = 6$) and experimental error ($n = 2$). The final sample consisted of 69 infants (29 males and 40 females). They were seen at 5 months (M = 168.28 days, SD = 7.22), 7 months (M = 226.59 days, SD = 10.11), and at 9 months of age (M = 296.10 days, SD = 11.51). All participants were healthy and full-term, and recruited from a city hospital of a mid-size town in the east of Germany. Caregivers received a videotape of all the sessions, a small gift for the infant, and a travel allowance.

Procedure

Testing took place in a carpeted room within an area surrounded by white curtains to eliminate any possible distractions. The infant and an interaction partner sat 60 cm across from each other on the floor. Several toys (e.g., picture book, various rattles) were placed between the infant and the interaction partner. The interaction partner was either the infant's mother or a stranger. The order of the interaction partner was counterbalanced across infants and determined a priori. Infants and interaction partners played with the toys during a 2 min freeplay session.[1]

During the mother-infant interaction session, the mother engaged the infant in freeplay with the toys while the stranger sat unobtrusively on the floor behind the infant and, if needed, held the infant in a way that it did not restrict the infant's toy exploration. The position of the mother and stranger were reversed in the stranger-infant play session. The

[1] The 2 min freeplay sessions were embedded within a battery of tasks that lasted approximately 20 min in total. These tasks are not considered in the current study.

interaction partners were instructed to engage with the infant and the toys in normal play. Play sessions were filmed with four digital video cameras. One camera captured a front close-up view of the infant, another a profile view of the infant and the interaction partner, a third the interaction partner, the infant, and the toys, and a fourth camera the top view of the entire play setting.

The familiar interaction partner was always the infant's mother. In order for the stranger to be a novel person to the infant, different strangers were used across visits.[2] A total of six strangers were used as unfamiliar interaction partners. Preliminary analyses indicated that type of stranger did not influence infants' performance (*JE-looks* and *JE-looks with smile*: all *p*s > .1). The play behaviour of the mothers and the strangers was analysed to examine if they behaved similarly during the play sessions. The results revealed that mothers and strangers did not significantly differ in the time they manipulated the toys ($t = 0.23$, $p > .05$), smiled at the infant ($t = -1.27$, $p > .05$), and talk to the infant ($t = 0.66$, $p > .05$).

Dependent variables

The 2 min freeplay sessions were coded from videotapes by a trained coder blind to the hypotheses of the study. The following behaviours were coded.

Joint engagement looks (JE-looks). Infants' gaze from a toy to the interaction partner's face and back to the same toy were counted as *JE-looks*. Infants' looks back to a different toy were not coded as *JE-looks*. Any looks to the interaction partner in response to her speaking or moving were not counted. Infants received a ''1'' if they displayed the behaviour at least once during the 2 min play session. Infants who did not display the behaviour received a ''0''.

Joint engagement looks with smile (JE-looks with smile). Infants who received a ''1'' in the above measure, were scored again to determine if the *JE-looks* were accompanied by a smile. A smile was defined as cheeks raised and at least one corner of the mouth turned up while looking at the interaction partner. Only infant-initiated smiles during *JE-looks* were counted. Smiles in response to the interaction partner's smiles were not counted. Infants received a ''1'' if at least one *JE-look* was accompanied with a smile. Infants who never smiled during *JE-looks* received a ''0''.[3]

To assess intercoder reliability, a second, naive coder scored a random 20% of the freeplay sessions. The agreement between the two observers was Cohen's kappa .94 for the *JE-looks* and Cohen's kappa .73 for *JE-looks with smile*.

[2] Two infants played with the same stranger in two of their visits.

[3] *JE-looks* and *JE-looks with smile* are not mutually exclusive measures. Receiving a ''1'' for *JE-looks* indicated that the infant displayed one or more joint engagement look regardless of positive affect. Receiving a ''1'' for *JE-looks with smile* indicated that at least one of the infant's *JE-looks* was accompanied by a smile.

RESULTS

JE-looks

Table 1 displays the frequency of *JE-looks* and *JE-looks with smile* for the mother and stranger condition. Separate nonparametric tests for repeated samples with binary measures were conducted to assess age effects for both social partners (mother and stranger). A Cochran Q test revealed that there were no systematic differences in the number of infants who displayed *JE-looks* while playing with their mother at 5, 7, and 9 months of age $Q(2) = 4.68$, $p > .05$. However, for the stranger condition, there was a reliable difference in the number of infants who displayed *JE-looks* across the different ages, $Q(2) = 32.01$, $p < .001$. Follow-up McNemar (Siegel & Castellan, 1988) chi-square pairwise comparisons indicated that the number of infants who coordinated attention with strangers at both 7 and 9 months of age was significantly higher than the number of infants who engaged in this behaviour at 5 months of age ($p < .001$ in both cases). The number of infants who coordinated attention with strangers at 7 and 9 months of age did not differ (McNemar, $p > .05$).

Additional McNemar chi-square tests revealed that at both 7 and 9 months of age, significantly more infants coordinated attention with strangers than with mothers (7-month-olds: $p < .01$; 9-month-olds: $p < .001$). The frequency of *JE-looks* between the mother and stranger condition did not differ for infants at 5 months of age (McNemar, $p > .05$). This result points to a differentiation in the production of *JE-looks* with mothers versus strangers by 7 months of age.

JE-looks with Smile

Table 1 shows the number and percentage of infants who accompanied at least one *JE-look* with a smile to the mother and stranger. For the mother condition, a Cochran Q test revealed a reliable age effect in the number of infants that displayed *JE-looks with smile*,

TABLE 1
Frequency (and percentage of total infants) of each target behaviour in the mother and stranger condition at 5, 7, and 9 months

	Age (months)					
	5		*7*		*9*	
Behaviour and condition	*f*	*(%)*	*f*	*(%)*	*f*	*(%)*
JE-looks						
Mother	20	(28.99)	31	(44.93)	29	(42.03)
Stranger	21	(30.43)	48	(69.57)	52	(75.36)
JE-looks with smile						
Mother	2	(2.90)	9	(13.04)	12	(17.39)
Stranger	3	(4.35)	8	(11.59)	24	(34.78)

Note: Frequencies (f) constitute numbers of infants who displayed behaviours at least once during the 2 min play session. Percentages are based on 69 infants.

$Q(2) = 8.32$, $p < .02$. Follow-up McNemar chi-square pairwise comparisons indicated that the number of infants who accompanied at least one *JE-look* with a smile was significantly higher at 9 months of age compared to 5 months of age ($p < .01$), and marginally higher at 7 months compared to 5 months of age ($p = .06$). There were no other significant differences.

The number of infants who smiled while coordinating their attention with strangers was significantly higher at 9 months of age than at 5 and 7 months of age ($p < .001$ and $p < .01$ respectively). In addition, 9-month-olds were more likely to accompany their *JE-looks* with smiles when playing with strangers than with mothers (McNemar, $p < .005$). There were no other significant differences. Together, these analyses reveal that the number of infants who accompanied joint engagement looks with positive affect increased with age regardless of social partner. Also, at 9 months of age the number of infants who displayed *JE-looks with smile* was significantly higher in the stranger than in the mother condition.

The general finding that *JE-looks with smile* increased similarly in the mother and stranger condition was corroborated with a binary logistic regression model with repeated measures. The analyses revealed that *age* (5-, 7-, and 9-month-olds) had a significant effect (Wald $\chi^2(1) = 9.92$, $p < .01$; $e^{\beta} = 1.69$) on *JE-looks with smile*.[4] Thus, with development, infants increasingly coordinated joint engagement behaviour with smiles. There were no other main effects or interactions, suggesting that this pattern of results was similar for both the mother and stranger as interaction partner.

DISCUSSION

In a longitudinal study that assessed infants between 5 and 9 months of age, we investigated how infants coordinate affect with joint (triadic) attention. Although visual joint engagement has been documented in infants older than 9 months of age (i.e., Carpenter et al., 1998), no large-scale longitudinal study has considered the developmental emergence of joint engagement or how affect and visual joint engagement are integrated over development. In addition to asking these fundamental questions, the study assessed whether the integration of joint engagement and affect followed a similar pattern when infants interacted with mothers versus strangers.

The developmental effects of the current study point to a much earlier and more gradual emergence of joint engagement than has been proposed by other researchers (see also Striano & Bertin, in press; Striano & Rochat, 1999). Although the results show an increased coordination of affect and attention by the end of the first year, the transition to joint engagement was not as abrupt as suggested by some researchers (i.e., Tomasello, 1995, ''9-month-revolution''). In fact, many infants in the current study were coordinating visual attention with mothers and strangers by 5–7 months of age.

The study revealed that in relation to the interaction partner, the number of infants who engaged in coordinated attention changed with age only in the stranger condition. In addition, by 7 months of age infants were more likely to coordinate looks with strangers than with mothers. Thus, our hypothesis that infants would engage in more

[4] e^{β} is the predicted change of odds for a unit increase in the covariate (Tabachnick & Fidell, 2001). In the current study, this means that for every 1 month increase in age, it will be 1.69 more likely than in the previous month, that *JE-looks with smile* occur than not.

coordination (as indexed by *JE-looks*) with strangers than mothers was supported. The findings with the interaction partner suggest that context may play a key role in the establishment of joint attention. The increased *JE-looks* with strangers compared to mothers is in line with prior research with younger infants showing more coordination with strangers than mothers (e.g., Jaffe et al., 2001). It is important to note that, although there were no differences in this general pattern of results as a function of the different unfamiliar interaction partners, the meaning of this effect will rely upon further investigations. For instance, context effects or the quality of a stranger's interactive style in general and also relative to the infant's prior experience may play a key role (see also Bigelow, 1998).

The pattern of results was different for the coordination of joint engagement and affect. In general, the study revealed that with development, infants are more likely to coordinate their joint engagement behaviour with positive affect. The number of infants who accompanied joint engagement looks with positive affect increased with age regardless of the interaction partner. Only by 9 months of age, the number of infants who coordinated *JE-looks* and *JE-looks with smile* was significantly higher in the stranger than in the mother condition. The coordination of affect and joint engagement points to a possible shift in the meaning of this skill by the end of the first year. In general, the findings are in line with Hobson's ideas that: ''Jointness comes with being moved just enough to sense the psychological orientation of the other in oneself, but as the other's. This happens through intersubjective engagement that is emotional in source and emotional in quality'' (Hobson, in press). Future studies will be needed to determine which factors underlie this developmental shift given that infants coordinate affect in dyadic contexts much earlier (see Murray & Trevarthen, 1986; Nadel, Carchon, Kervella, Marcelli, & Reserbat-Plantey, 1999; Rochat, Querido, & Striano, 1999). However, the increase of *JE-looks* at 7 and 9 months of age and coordination of *JE-looks* with smiles by 9 months of age with strangers compared to mothers suggests that this behaviour is not the result of associative learning mechanisms.

Differences in the coordination of joint engagement and smiles as a function of the interaction partner may be revealing in this regard. The current pattern of results is different from that of Bakeman and Adamson (1984) who compared the coordination of affect with mothers versus peers and found greater coordination with the mother. Again, these differences could point to potential context effects given that the adult strangers in the current study likely had a much more expansive social repertoire than infant peers. Future studies will be needed to manipulate and bias infants' joint engagement and affect toward strangers, for instance by having infants interact with an unfriendly or non-contingent stranger.

The ability to coordinate attention with another person is a necessary precursor for many aspects of human cultural learning. For example, understanding the reference of another's gaze is necessary for social referencing, language learning (Baldwin, 1993, 1995; Morales, Mundy, & Rojas, 1998; Mundy & Gomes, 1998), and imitative learning (e.g., Brooks & Meltzoff, 2002). However, while such skills may be necessary pre-requisites to uniquely human capacities, coordinating visual attention is certainly not a unique human capacity (see Emery, 2000, for a review). The accompaniment of affect with the coordination of gaze, however, is only observed in humans. The timing and coordination of smiling and joint engagement may be the key to the developmental social-cognitive transition reported by the end of the first year.

The current findings show the emergence of joint engagement before the end of the first year. In addition, these results suggest that assessing early development may be key in pointing to meaningful transitions in social-cognitive competencies across early ontogeny. Along these lines, the current findings are consistent with Mundy and colleagues (e.g., Kasari, Sigman, Mundy, & Yirmiya, 1990; Mundy et al., 1992; Mundy & Sigman, 1989) who propose that the initiation of joint attention behaviours *accompanied* by positive affect may not be the same as other types of joint attention behaviours, such as gaze following or requesting, which do not necessarily consist of an affective component. When one takes affect into account, as was done in the current study, more clear developmental patterns may be observed than in prior studies (e.g., Carpenter et al., 1998). The coordination of positive affect with gaze was not considered by Carpenter and colleagues (1998) and might have contributed to the relatedness among many of the joint attentional skills considered by these authors. That is, it is conceivable that none of these joint attention tasks may have been indexing the sharing of affect that makes coordinated attention truly joint, or a meaningful shared experience (Hobson, 2002, in press).

A consideration of the interplay between affect and triadic social skills over the course of ontogeny is a fruitful avenue for future research. In addition, it will be important to assess mechanisms of developmental change. That is, many infants in the current study were coordinating visual attention with mothers and strangers by 5 months of age, but only a few infants at this age coordinated affect with visual joint engagement. The question remains whether the 5-month-olds in the current study simply could not coordinate triadic visual attention and affect due to possible memory or attention constraints (see Ruff & Rothbart, 1996), or whether they did not engage in such behaviour because they lacked an awareness of intentional relations. Clearly, further studies are needed to assess the meaning and the developmental course of various joint attention tasks, such as attention following and social referencing. The initiation of coordinated attention with positive affect may index the active attempt by the human infant to share emotional states with others about things in the world. As suggested by the current findings and by Hobson (in press) affect may be what puts ''jointness'' into joint engagement.

Manuscript received 14 October 2003
Revised manuscript received 7 October 2004

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