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Developmental link between dyadic and triadic social competence in infancy

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The social responses of 48 7- and 10-month-old infants were analysed and compared in the context of dyadic and triadic situations. In the dyadic situation, infants' reactions to a sudden 1 min still face adopted by a social partner in a face-to-face interaction were recorded. In the triadic situation, infants' monitoring of a social partner in various situations of object exploration was recorded. Results indicated that specific responses in a dyadic context correlate with responses expressed by the infant in a triadic context. At either age, infants that demonstrated attempts to re-engage the experimenter during the still-face episode in the dyadic situation were also those who manifested the most signs of joint engagement, attention following and attention monitoring in the triadic situation. These findings are interpreted as the demonstration of a developmental link between dyadic and triadic social competence in infancy.

The ability by 9-month-old infants to follow an adult's line of gaze or pointing toward an object marks an important transition in social cognitive development. This ability indexes the emergence of a shared reference to objects in the environment or triadic social competence (Scaife & Bruner, 1975). Triadic social competence also underlies 9-month-olds' new propensity for joint engagement or attention, when they start to monitor others for their simultaneous attention to the object they explore (Bakeman & Adamson, 1984). By 9 months, infants also start to show evidence of using their mother's emotional display as information to disambiguate novel situations in the environment, such as the encounter with an unknown mechanical toy (robot), a visual cliff, or with a stranger (Campos Stenberg, 1981). The emerging ability for such social referencing indicates that infants begin to perceive and understand their mother as sharing views on their own situation in the environment, reflecting back to them what they should anticipate and potentially fear (Bretherton, 1991).

The co-emergence at around 9 months of an understanding of communicative gestures (Bates, Benigni, Bretherton, Camaioni & Volterra, 1979), the behavioural manifestation of joint engagement and social referencing, is also considered as indexing the developmental origins of an intentional stance—infants starting to perceive and understand others as intentional agents (Bretherton, 1991; Carpenter, Nagell & Tomasello, 1998; Tomasello,

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1995). The developmental question of what announces and prepares this development, sometimes described as the 9-month 'miracle' or 'revolution' (Tomasello, 1995), remains remarkably open. The present research is motivated by this question.

Prior to 9 months, infants manifest social competence in the context of dyadic situations or face-to-face exchanges with social partners. Evidence of neonatal imitation suggests that infants are born with a rudimentary ability to reciprocate with others (Meltzoff & Moore, 1977). Multiple converging evidence from different laboratories indicates that newborn infants have the ability to imitate the tongue protrusion modelled by others (see Anisfeld, 1991, for a review). Aside from imitation, long before 9 months infants have been shown to engage in complex interpersonal exchanges or protoconverstations. The affective attunement and emotional coregulation that include subtle turn taking and co-constructive dialogues and coregulation between infants and caretakers (Fogel, 1993; Stern, 1985) has been equated to the expression of a primary intersubjectivity or primary sense of shared experience (Trevarthen, 1979). If it is assumed that protoconversations between young infants and their caretakers are associated with intersubjectivity, it could be an important source of social cognition, hence a determinanr of the development leading infants by 9 months to triadic social competencies (Rochat & Striano, 1999).

There is some evidence that young infants, at least from 2 months of age, start ro be sensitive to interpersonal contingency. Murray & Trevarthen (1985) reported rhat as early as 2 months, infanrs react more positively was their mother interacting with them 'live' via a close circuir video system, compared with the video presentation of a replay of their mother. This phenomenon in the context of this particular experimental paradigm is conrroversial and might be due to uncontrolled variables (Rochat, Neisser & Marian, 1998). However, other researchers confirmed Murray & Trevarthen's findings with 5-month and older infants, using female strangers rather than mothers as social partners (Bigelow, MacLean & MacDonald, 1996; Muir & Hains, 1993). One of the most robusr phenomenon demonstrating protoconversational ability is the negative effects caused by the sudden still face adopted by a social partner in a face-to-face interaction with the infant at around 5–6 months of age (Tronick, Als, Adamson, Wise & Brazelton, 1978). In the traditional still-face paradigm, infants engage for several minutes in a normal face-ro-face inreraction with an adult social partner. This dyadic interplay is halted when the adult suddenly adopts and holds a neutral still face for about 1–2 min. Infants are shown ro react to the still face with a significant increase in negative affects expressed via reduced eye contacts, reduced smiling, together with increased drooling and self-comforting that are typically associated with social stress (Mayes & Carter, 1990; Muir & Hains, 1993; Toda & Fogel, 1993; Tronick *et al.*, 1978). This reaction to the still face is interpreted as the expression of social expectations by the infant, and the sense of a disruption of positive coregulation (Hains and Muir, 1996; Tronick, 1989).

In the perspective of early development, Cohn & Tronick (1987) have examined longitudinally the sequential structure of face-to-face interaction between infants and mothers' dyads, at 3, 6 and 9 months post-partum. They found that it is only by 9 months that infants display clear social initiatives in the interaction (e.g. smiling before their mother). At younger ages, the mother systematically initiated the positive emotional displays in their infant. This developmental finding matches the age at which infants are reported to start demonstrating joint engagement and other triadic competence. Ir is thus possible that emerging social initiatives in a dyadic, face-to-face context are linked to the development of triadic competencies. However, it is also possible that dyadic social initiatives and triadic behaviour are unrelated, their development being parallel but independent of one another. In other words, this second alternative is that dyadic and triadic competencies are domain specific (dyadic or triadic contexts) rather than domain general. The present study is aimed at providing a more direct empirical assessment of these two possible explanations.

The study tested and compared 7- and 10-month-olds' social behaviour in dyadic and triadic contexts. In the dyadic context, infants' reaction to the sudden still face adopted by a social partner was analysed. In the triadic context, the same infants were tested in various social situations involving the infant, an adult partner and an object. These triadic situations included gaze following, pointing, social teasing, social obstacle, and joint engagement tasks (see description below). The responses of each infant in these different social contexts were analysed and compared. Two empirical questions guided the research: (a) Is there a correlation between infants' social competence expressed in a dyadic and triadic context? and (b) If such a correlation exists, does it depend on age?

Overall, the rationale for this research was to assess the developmental link between dyadic and triadic social competence by the end of the first year. As working hypotheses, it was expected that 7–10-month-old infants would display novel behaviour in the dyadic, still-face situation, corresponding to the emergence of social initiatives previously reported by Cohn & Tronick (1987). In the particular context of the still-face situation, these initiatives were expected to manifest themselves in the form of attempts to re-engage the social partner via touching, vocalizing and smiling. In relation to the triadic tasks, it was expected that a significant correlation would be found between the amount of social initiatives expressed by the infants in the dyadic context and the number of responses indexing joint attention and social competence in the triadic context. In general, it was not expected that age *per se* would be a factor in this correlation, but rather differences in social-cognitive competence expressed in both dyadic and triadic contexts. Based on previous research indicating differences among the same aged infants' dyadic and triadic behaviours at the end of the first year (e.g. Carpenter *et al.*, 1998; Cohn & Tronick, 1987), it was expected that individual infants' responses would depend upon their social-cognitive competencies regardless of age, with some individuals manifesting many dyadic and triadic behaviours and others engaging in many fewer. It was predicted that infants' dyadic and triadic social responses would be related at both ages, both reflecting the same general social-cognitive competencies.

Method

Participants

Forty-eight healthy infants participated in the study, divided into two equal age groups of 7-month-old (*M* = 7 months 10 days, range = 6.28–7.3 months, 12 females and 12 males) and 10-month-olds (*M* = 10.0 months, range = 9.21–10.29 months, 8 females and 16 males). Infants were primarily from white, middle-class families living in the Greater metro Atlanta area. An additional 18 infants were tested (two 7-month-olds and sixteen 10-monrh-olds) bur excluded from the final sample because they failed to complete both phases of the study, becoming fussy and/or distracted. Infanrs were given a small gift for participating in the stndy.

Procedure

Each infant was tested successively in a dyadic (still-face) and a triadic (joint engagement) experimental phase. The order of these test phases was counterbalanced across infants at each age group. The specific procedure, technique and scoring for each of these phases are presented below.

Dyadic (still-face) phase

The dyadic (still-face) phase lasted 3 min and consisted of three episodes. First, there was a 1 min normal interaction episode in which a female adult experimenter (E1) engaged in a playful, contingent manner with the infant. Note that E1 was a stranger for the infant. This first contingent interaction episode consisted of infant-directed vocalization with peek-a-boo games, smiling and singing on E1's part. This first normal interaction episode was immediately followed by a 1 min still-face episode, in which E1 became suddenly silent, displaying a static, neutral expression while staring at the infant. Following the still-face episode, a 1 min normal interaction resumed, analogous to the first episode. E1 did not touch the infant during any of the episodes. A second experimenter (E2), not visible to the infant, timed the various episodes using a stopwatch and signalled E1 the beginning and end of an episode. Infant and experimenter were sitting facing one another at eye level, approximately 1 m apart. The infant was secured into a high chair facing the experimenter's chair. The 3 min of dyadic interaction was recorded simultaneously by three video cameras. Camera 1 (Panasonic model AG-186) provided a close-up view of the infant's face and trunk and a close-up profile view of E1. Camera 2 was a mini-video camera (Computer EM200-L38) mounted behind the infants' that provided a simultaneous close-up view of E1. Camera 3 was set up to the side of the infant and E1, providing a side-view of each. The three camera views were mixed and synchronized (Robot model MV45 screen splitter), with the addition of a digital clock with hundredth of seconds to appear on monitor 1 (Panasonic model CT 1382) and on the final taped image used for scoring (Panasonic model AG-1960). Camera 1 was also connected to a separate monitor (Panasonic model CT 1382) and S-VHS (Panasonic model AG-1300) for scoring.

Scoring and analysis. Video recording of the close-up view of the infant was coded by two naïve observers using a computerized event recorder. While viewing the online video recording of the infant's frontal view and pressing on a particular key of a computer corresponding to a specific behaviour, observers activated a channel of the event recorder. The coding pertained to the occurrence of the following behaviours, operationally defined as:

(1) *gazing*: infant looks toward the experimenter's face;
(2) *smiling*: infant's cheeks raised and the sides of the mouth turned up while looking toward the experimenter;
(3) *re-engagement vocalizing*: infant's vocalization accompanied by a look toward the experimenter's face;
(4) *re-engagement activity*: clapping, banging, or touching the experimenter while looking toward her.

For the analysis and based on the coding, the percentage of time was calculated for each behaviour over each successive 1 min episode (first normal interaction, still face, second normal interaction).

Inter-observer reliability. Reliability between the two independent coders was assessed based on 20% of all recordings in the three 1 min episodes of testing. For all dependent measures, mean Cohen's Kappas were between .88 and .93.

Triadic (joint attention) phase

The triadic phase took place in a separate experimental room. One camera (Panasonic model AG-186) was placed approximately 0.5 m from the nearest target object and recorded the infants' face and E1's profile view. The camera was connected to a small monitor (Sanyo model DMC 6013) which E2 controlled to ensure that the infant remained in view of the camera at all times. Infants were successively tested in four different experimental situations. For all situations, a female experimenter (E1) interacted with the infant and structured the tasks as follows:

(1) *Joint engagement*: E1 faced the infant, sitting on a mat. E1 placed several toys (a stuffed raccoon, a plastic boat, a rattle, a toy phone and a plastic Mickey Mouse toy) on the mat between her and the infant. The toys were left for 5 min during which the infant could freely explore them, with E1 remaining silent, except when the infant looked up toward her. Following each eye contact, E1 smiled and expressed a single vocal approbation such as a 'Yes!' or a 'Wow!' A second experimenter (E2), not visible to the infant, timed the session from behind a backdrop using a stopwatch, signalling E1 when the 5 min had elapsed. Frequency of joint engagement episodes were recorded from video recordings for each infant (see scoring).

(2) *Attention following (gaze and point following)*: For the gaze-following task, the infant was placed on a mat and facing E1 and was given a small toy to play with. When the infant was looking at the toy, E1 called the infant by name, waited for eye contact and then with an excited facial and vocal expression, turned her head for 3 s in the direction of one of two target objects placed in the room in front of the infant. E1 alternated her gaze between the infant's eyes and the target three or four times for a given trial, maintaining her excited expression and completely turning her head each time. Target A (plastic Big-bird) was located on the floor approximately 1.8 m away from and approximately 45° to the left of the infant. Target B (stuffed toy) was placed on the wall, about 0.5 m high, 1 m away from the infant and 75° to the right of the infant. The procedure for point following was the same as for gaze following except that rather than only gazing toward the target object, the experimenter turned her head and extended her arm and index finger toward the target. Two targets positioned in front of the infant were used in the point following task. Target C (stuffed toy) was positioned on a short shelf, approximately, 0.9 m high and 1.8 m from the infant and 75° to the left of the infant. Target D (stuffed toy) was located on the wall, approximately 0.9 m from the infant, positioned approximately 1.5 m high and 45° to the right of the infant. For both point- and gaze-following, E2 coded online whether the infant visually localized the target object (see scoring).

(3) *Blocking task*: E1 gave the infant a small toy. Once the infant was engaged with it, E1 covered the infant's hand with her own for 5 s. Infants were given three trials and E2 coded online whether infants looked to E1 for each trial (see scoring).

(4) *Teasing*: E1 offered a small toy to within reach of the infant. When the infant began to reach for the object, E1 withdrew the object for 5 s. Infants were given three trials. E2 coded online whether infants looked to E1 for each trial (see scoring).

Scoring and analysis. Based on the online observation plus video-recording used for reliability, the following behaviours were scored in relation to each triadic situation.

(1) *Joint engagement*: For the analysis, the frequency was calculated of joint engagement bouts performed by individual infants. A bout was defined as a look by the infant toward one of the objects, then followed immediately by a look toward E1's face, followed immediately by a look back to the same object.

(2) *Attention following:* For the analysis of the attention-following task, the frequency was calculated of times infants localized the target for the gaze-following and point-following task. Localizing was defined as a look at the correct target location for a duration of at least 1 s over target presentation. Frequencies were based from 0–4 with a minimum score of 0 (localizing no targets) and maximum score of 4 (i.e. localizing the two targets in the gaze-following and the two targets in the point-following task).

(3) *Blocking*: The authors scored whether infants looked at least once toward E1's face during the testing trials. Analyses were based on the frequency of infants receiving a score of 0 (no look to E's face) or 1 (at least one look for one of the trials).

(4) *Teasing*: The authors scored whether infants looked at least once toward E1's face during the testing trials. Analyses were based on the frequency of infants receiving a score of 0 (no look to E's face) or 1 (at least one look for one of the trials).

Inter-observer reliability. An independent observer scored 20% of the infants in all situations and conditions and for all dependent measures. Pearson *R* correlations were all .98 or above. Inter-observer reliability for the attention-following task was conducted online because it was not possible to judge whether infants had localized each of the targets from video records. Percentage agreement between two independent observers for task was .98.

Results

For clarity of presentation, the results of the dyadic and triadic phases are first presented separately. A combined analysis of the data from both dyadic and triadic phases is then presented.

Dyadic phase

Regarding the dyadic phase, the authors were interested in comparing the still-face effect and its magnitude across infants of each age group. For that, the percentage of time infants engaged in each of the four dependent measures during the first normal interaction, still-face, and second normal interaction episode were compared. To assess a still-face effect, infants' responses were compared between the first minute of normal interaction and the still-face episode. Assessment of an eventual recovery from still-face was performed based on a comparison of responses between still-face episode and second normal interaction. For each of these two comparisons and for each of the four scored measures, a 2 (age) × 2 (order: precedence or consequence of the dyadic phase in relation to the triadic experimental phase) × 2 (episode) mixed design analysis of variance ANOVA was performed. Table 1 presents a summary of the ANOVA results. Overall, for all measures, the ANOVA yielded no significant effect of age or order, nor any significant interactions ($p > .23$ in all cases). However, significant episode main effects were found in both the still-face effect and its recovery. As indicated in Table 1, infants manifested reliably more re-engagement vocalization, less smiling, as well as less gazing during the still-face episode compared with the first 1 min of normal interaction. In all, these results indicated a marked still-face effect at both ages. Analyses also revealed a significant recovery main effect following the still-face episode, with significantly more gazing and decrease in re-engagement activity during the 3rd min of normal interaction (see Table 1).

Triadic (joint attention) phase

Regarding the triadic experimental phase, results are presented for each of the four experimental situations. Concerning the triadic phase, the authors were interested in determining if there were age effects for any of the four experimental situations.

A one-way ANOVA comparing 7- and 10-month-olds was performed on the frequency of joint engagement bouts. There was a marginally significant age effect ($F(1,46) = 3.12$, $p = .08$, $M = 3.62$ looks for 7-month-olds and $M = 5.58$ looks for 10-month-olds). A series of χ^2 analyses comparing the frequency of 7- and 10-month old infants who looked to the experimenter during the blocking and teasing tasks yielded no significant age difference in either task.

The same non-parametric analysis comparing the frequency of 7- and 10-month-old infants who localized the target for the attention-following tasks indicated significant age effects for all targets in the gaze-following tasks ($\chi^2(1,48) = 9.4, p < .01$) for target A;

Table 1. Mean percentage of time and SD for the first normal interaction, still-face and re-union phases

Dependent measure	Normal interaction (SD)	Still-face (SD)	F (Still-face)	Re-union (SD)	*F* (Recovery)
Gazing	61.36 (15.15)	33.81 (20.30)	88.56*	58.24 (20.53)	37.62*
Smiling	5.22 (7.44)	1.80 (3.39)	9.16*	3.67 (7.21)	2.49
Re-engagement activity	3.15 (4.57)	5.00 (7.60)	3.14	2.22 (3.80)	5.55*
Re-engagement vocalize	1.04 (3.10)	3.00 (6.12)	4.57*	5.75 (9.86)	3.95

Note. F (Still-face) pertains to the comparisons between the first normal interaction and the still-face episode. *F* (Recovery) pertains to the comparison between the still face episode and the re-union episode. Degrees of freedom for all analyses was $F(1,44)$.
$*p < .05$

$\chi^2(1,48) = 5.3, p < .05$ for target B). No age effect was found for localizing either target (i.e. target C and D) for the point-following task.

Comparison of dyadic and triadic behaviours

In order to determine if there was a relationship between dyadic and triadic social behaviours, infants at both ages were categorized as high and low for level of dyadic and triadic social competence. The following criteria and rationale for determining levels of dyadic and triadic behaviour were used.

Levels of dyadic social behaviours. The authors assessed infants' re-engagement behaviours that were directed toward E1 during the still-face episode. Given that infants could manifest several types of social initiatives during the still-face episode, the authors coded for (1) smiling (2) re-engagement activity, and (3) re-engagement vocalizing, using the following rationale and criteria. Given that the percentage of duration of smiling generally decreased during the still-face episode compared with the first normal interaction (see Table 1), any manifestation of smiling during the still-face episode was considered as an index of social initiative. Infants were considered as manifesting a social initiative during the still-face episode if they smiled at least once for any duration of time. For re-engagement activity and re-engagement vocalizing, these criteria were more stringent given that the percentage duration of each of these behaviours was greater during the still-face episode compared with the first normal interaction. It was considered re-engagement activity and re-engagement vocalization during the still-face was indexing social initiative when infants manifested an *increase* in percentage duration of these behaviours during the still-face episode relative to the first normal interaction.

Occurrences of smiling, re-engagement activity and re-engagement vocalizing during the still-face episode were considered as different attempts to re-engage the still-faced experimenter. Infants were scored on the basis of whether they showed 0, 1, 2 or 3 of the possible categories of re-engagement activity. A score of 0 indicated no signs of re-engagement attempt during the still-face episode. A score of 3 indicated signs of all re-engagement attempts during the still-face episode. Infants scoring 0 and 1 were considered to be *low* initiators and those scoring 2 or 3 were considered to be *high* initiators.

Levels of triadic social behaviours. Infants were categorized as high or low for triadic social behaviours, based on their composite score derived from joint engagement, attention-following, blocking and teasing. The goal was to obtain a global assessment of triadic social behaviours that could be compared to the scoring of dyadic behaviours described above.

Infants' overall performance in rhe triadic phase of the experiment was assessed on the basis of a score combining joint engagement, attention-following, blocking and teasing tasks. Infants were evaluated as demonsrrating triadic level competence based on the following criteria for each of the four tasks. These criteria were determined *a posteriori*, and in relation to average values. Infants were given a score of 1 for each task (maximum overall score of 4, see below) if they demonstrated at minimum the following behaviour:

(1) *Joint engagement*: four or more joint looks during the 5 min joint engagement episode;
(2) *Attention following*: Following either gaze or point to at least two targets;
(3) *Blocking*: looking towards E1's face for at least one of three trials;
(4) *Teasing*: looking toward E1's face for at least one of three trials.

Infants were scored on the basis of whether they showed 0, 1, 2, 3 or 4 of the possible scores of triadic competence. Infants scoring 0 to 2 were considered as *low* for triadic competence, and those scoring 3 to 4 were considered as *high* for triadic competence.

In order to determine if there was a relationship between levels of dyadic and triadic competence, analyses were performed on the dyadic and triadic scores. A Pearson correlation between dyadic and triadic scores yielded a significant result ($r = .75, p < .01$). Chi square analysis was performed to compare the frequency of infants with high and low scores for dyadic and triadic social behaviours yielding a significant result ($\chi^2(1,48) = 15.94, p < .01$) (see Figure 2). To assess further this latter result, the same comparisons were performed for both 7- and 10-month-olds treated separately. Results indicated a significant effect for 7-month-olds ($\chi^2(1,24) = 15.30, p < .01$) and a marginally significant effect for 10-month-olds $\chi^2(1,24) = 3.31, p < .069$).

Discussion

The primary aim of the study was to determine the relationship between infants' dyadic and triadic social competence. To establish whether a developmental link exists between the development of dyadic and triadic social competencies, 7- and 10-month-old infants were tested in a still-face procedure and several joint attention situations. Based on the increase in social initiatives at 9 months reported by Cohn & Tronick (1987), it was predicted that by 7–10 months infants would attempt to re-engage the experimenter by exhibiting behaviours such as smiling, touching and vocalizing during the still-face episode. A correlation between the amount of social initiatives during the still-face (dyadic) phase and the expression of joint attention behaviours in the triadic phase was expected also.

In relation to the dyadic phase, it was found that 7- and 10-month-old infants responded similarly to the still-face, dyadic phase of experiment. Infants looked away and smiled less at the experimenter during the still-face episode compared with the normal interaction. In terms of recovery from the still-face episode, infants looked longer to the experimenter during the second normal interaction, but they did not exhibit a rebound in smiling. These findings coincide with previous studies with somewhat younger infants (6-month-olds; Weinberg & Tronick, 1996) and suggest that by 7 months infants form social expectations, and based on these expectations regulate their behaviour in subsequent social interactions. The lack of rebounding in smiling suggests that the previous still-face episode impacts on the infants' relation to the experimenter, infants being less inclined to re-engage in smiling (see also Muir & Hains, 1993).

Seven- and 10-month-old infants performed similarly across most of the joint attention tasks. There was no difference for number of joint engagement bouts, point-following behaviours, and instances of look toward the experimenter in blocking and teasing tasks. One significant age difference was found regarding the gaze-following task. Ten-month-

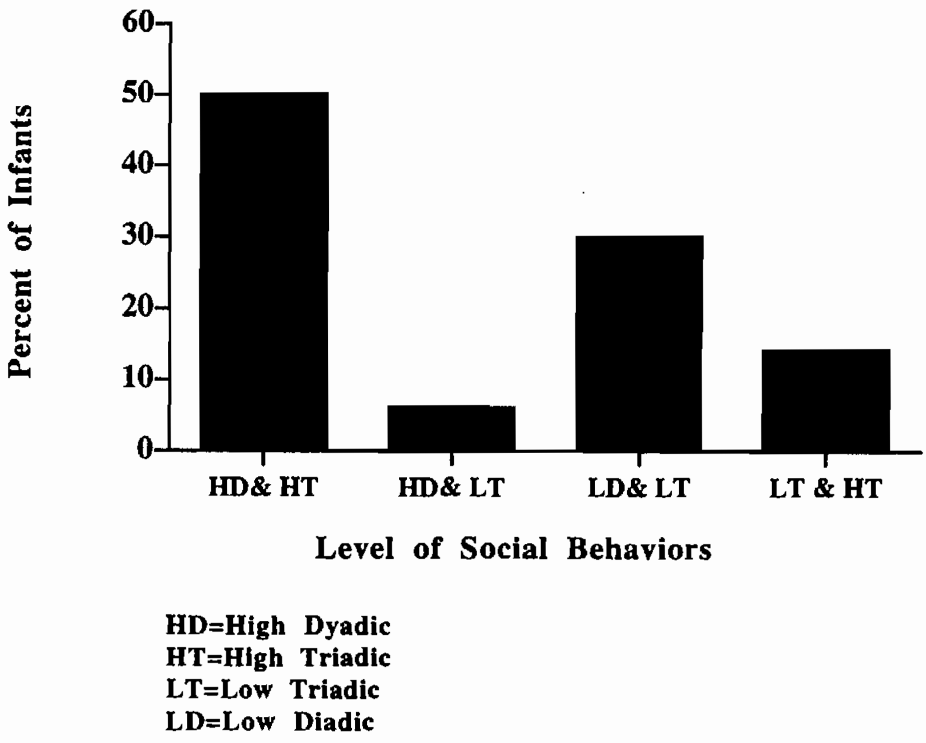

Figure 1. Percentage of infants scoring high and low for dyadic and triadic social behaviours

olds were significantly more inclined to follow gaze as compared with 7-month-olds. To a large extent, these findings are consistent with previous studies assessing the onset of triadic social behaviours. For example, Carpenter *et al.* (1998) found that by 9 months, the starting age of their study, all infants demonstrated some joint engagement. Furthermore, the present findings are consistent with theirs in relation to the developmental precedence of point-following over gaze-following, despite the fact that the present coding criteria were less stringent. The present study confirmed the original hypothesis of a developmental link between a dyadic and triadic social competence. Infants who had high scores during the triadic phase of the study were also those who demonstrated high scores in social initiatives and re-engagement during the still-face episode of the dyadic phase.

One possibility might be that this developmental link rests on interindividual differences in terms of relative sociability, and not in terms of a linked social cognitive ability across dyadic and triadic social contexts, as hypothesized. Accordingly, infants that have a stronger propensity to engage in social interaction would show more of a link between dyadic and triadic competence, independently of comparable social cognitive abilities. In other words, sociability would be the control variable of the reported developmental link, independently of changes in social cognitive abilities across tasks. To test this interpretation, a Pearson r correlation was performed on the number of social initiatives (smiling, re-engagement activity, re-engagement vocalization) manifested by the infant during the first normal interaction in the dyadic task and the number of triadic social behaviours performed in the triadic task. No significant correlation was found ($r = -.043$). In other words, the level of social engagement in either context did not correlate. Another possibility is that differences in relative maturation influence infants' responses across contexts independently of sociability or social competence *per se*. A maturational account would predict infants' dyadic and triadic responses to be linked to their age, such that 10-month-olds might demonstrate dyadic and triadic behaviour not observed in 7-month-olds. This was clearly not the authors' observation. Rather, they found that infants who manifested the most signs of dyadic competencies were the same ones who displayed the most triadic social competencies independently of age.

Related to this observation, it is worth noting that the authors considered infants' crawling ability as an index of their maturation. They assessed whether infants were crawling (locomoting on their hands and knees), belly-crawling (locomoting on their stomach) or not crawling (no method of independent locomotion), and performed a Pearson r correlation between crawling type and dyadic and triadic scores. The analyses yielded no significant relation between crawling and infants' dyadic score ($r = .07$) or triadic score ($r = .19$). The same was true when considering the group of 7- and 10-month-olds separately. This finding suggests the development of domain general *social* competencies, and not that emerging skills in dyadic and triadic contexts are the byproduct of general maturational factors.

The interpretation is that the co-emergence of new dyadic social responses (e.g. social initiatives) and triadic responses are related, and specific social behaviours that similarly index emerging social competencies and an understanding of others (namely an appreciation of other people) as intentional. The lack of age effects in the current study suggests a somewhat more gradual process of social cognitive developments than that implied by a suddenly emerging '9-month-revolution' (e.g. Tomasello, 1995).

If dyadic and triadic social competence in infancy does not appear to develop in independence, questions remain regarding the nature of their relationship in development. Dyadic competence is manifested early in development, infants starting by the second month to show evidence of affective attunement, emotional coregulation, sensitivity to interpersonal contingency and social expectations (e.g. Fogel, 1993; Muir & Hains, 1993; Murray & Trevarthen, 1985; Nadel, 1999; Stern, 1985). Because triadic competence such as joint engagement, social referencing and the understanding of symbolic gestures emerge at around 9 months (Bates *et al.*, 1979; Carpenter *et al.*, 1998), it appears that the developmental link observed in the present research is probably due to a carry-over of social competence developing first in dyadic, face-to-face situations. We propose that this development pertains to general social-cognitive competencies (e.g. social initiatives) that expand to include the control of social behaviours in both dyadic and triadic contexts.

Following Tomasello (1995) and Carpenter *et al.* (1999), a social-cognitive revolution occurs at around 9 months when infants start to perceive and understand others as intentional agents. By this age, infants manifest new social initiatives and expectations, based on the consideration of others' focus of attention, perspective on things, and intended actions. They are building mutual reference to events and objects, starting to express secondary subjectivity (Bruner, 1982; Trevarthen, 1979). The present research shows that such general social-cognitive progress, or lack of, is reflected in the behaviour of 7–10-month-old infants in both face-to-face and triadic contexts. Future research should help to specify further the transition from dyadic to both dyadic and triadic social competence.

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