Attention engagement in early infancy

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A R T I C L E   I N F O

Article history:
Received 29 July 2011
Received in revised form 28 May 2012
Accepted 8 June 2012

Keywords:
Longitudinal study
Infancy
Attention
Social attention
Attention engagement
Attention control
Development
Early development

A B S T R A C T

We report a longitudinal study investigating developmental changes in the structure of attention engagement during early infancy. Forty-three infants were observed monthly from 2 to 4 months. Attention engagement was assessed from play interactions with parents, using a coding system developed by Bakeman and Adamson (1984). The results indicated a developmental transition in attention engagement at 3 months: after this age infants engaged for longer periods and in a wider variety of states. Most infants displayed person engagement at 2 months, passive joint engagement at 3 months, and object engagement at 4 months. To address whether emerging abilities of attention engagement allow infants to follow the attention of social partners, we compared attention engagement to performance on an experimental measure of attention control (reported by Perra & Gattis, 2010). Analyses revealed a positive relation between passive joint engagement and checking back, suggesting that changes in passive joint engagement reflect the development in attention control.

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1. Introduction

Visual attention changes significantly across the first year of life. The earliest of several changes is an increase in alertness, and as a result, an increase in attention engagement (Colombo, 2001; Ruff & Rothbart, 2001). Attention engagement allows individuals to process information from the environment and is a significant topic in developmental psychology because it is thought to support infant attention to the visual and mental foci of other people, a process known as joint attention (Bakeman & Adamson, 1984; Oakes & Tellinghuisen, 1994; Richards, 1998; Ruff & Rothbart, 2001). Joint attention in turn supports many aspects of cognitive development, including language and other forms of communication. Together these results suggest that attention engagement may play a pivotal role in early cognitive development (Carpenter, Nagell, & Tomasetto, 1998; Morales et al., 2000; Mundy et al., 2007).

In a landmark study, Bakeman and Adamson (1984) examined infants’ ability to coordinate attention between a social partner and a shared object of interest, such as a toy. They observed infants interacting with their mothers and with peers on four occasions at roughly equal intervals longitudinally from 6 to 18 months. They defined six states of engagement – unengaged, onlooking, person engagement, object engagement, passive joint engagement, and coordinated joint engagement – and identified the ages and conditions in which infants demonstrated each of those states. In order to achieve coordinated joint engagement, an infant must be capable not only of engaging with people and with objects, but critically must also be capable of coordinating attention between the two. In both passive joint engagement and coordinated joint engagement, the infant and social partner focus attention on the same object. In coordinated joint engagement, however, infants move...
beyond passive joint engagement by also directing attention to the social partner, switching back and forth between these two foci.

Bakeman and Adamson reported that from 6 to 18 months, infants decreased in the amount of time spent in person engagement, and increased in the amount of time spent in coordinated joint engagement. In addition, infants demonstrated both passive joint engagement and coordinated joint engagement more frequently with skilled social partners (their mothers) compared to unskilled social partners (their peers). Although most infants demonstrated both passive joint engagement and coordinated joint engagement at each of the observed ages, the average time spent in coordinated joint engagement was minimal (less than 10%) until 15 months. Importantly, subsequent longitudinal studies have documented relations between engagement states and later cognitive and communicative abilities, much like the role of joint attention (e.g., Adamson, Bakeman, & Deckner, 2004; Nelson, Adamson, & Bakeman, 2008; Trautman & Rollins, 2006).

In the years since Bakeman and Adamson’s study, observational and experimental studies of infant attention have identified an important transition in infant attention around the second to third month of life. This transition includes an increase in alertness, a decrease in obligatory attention or “sticky fixation,” and a corresponding increase in disengagement, a process that allows infants to terminate attention to one specific stimulus and explore more aspects of the visual environment (Butcher, Kalverboer, & Geuze, 2000; Colombo, 2001; Hunnius & Geuze, 2004; Hunnius, Geuze, & van Geert, 2006; Lavelli & Fogel, 2005; Ruff & Rothbart, 2001). As a result of these changes, infants are increasingly able to control their attention and explore their environments visually. Observational and experimental evidence also suggests that infants are able to utilize their expanding attentional abilities to monitor and even follow the attention states of others in some, specifically constrained situations that have been called precursors to joint attention or social attention (Amano, Kezuka, & Yamamoto, 2004; Legerstee, Markova, & Fisher, 2007; Striano, Stahl, Cleveland, & Hoehl, 2007; Tremblay & Rovira, 2007). For example, as early as 6 weeks, infants show some ability to discriminate when an adult does or does not divide attention between an object and the infant (Striano et al., 2007).

At around 3 months, infants begin to follow the attention of social partners (D’Entremont, Hains, & Muir, 1997; Greedback, Fikke, & Melinder, 2010; Perra & Gattis, 2010). Perra and Gattis (2010) tested 1- to 4-month-olds longitudinally on a task measuring two aspects of social attention, proximal attention following and checking back. An experimenter faced the infant and held two puppets, one near each of his shoulders, and thus within the infant’s visual field. The experimenter engaged the infant’s attention, and slowly turned his head toward one of the two puppets, and continued looking at the puppet for 10 seconds, all whilst speaking softly in infant-directed speech to maintain the interaction. Perra and Gattis considered two dependent measures of social attention. Proximal attention following referred to infant looks to the same puppet as the experimenter. Checking back referred to infant gaze alternations between the experimenter and the puppet at which the experimenter was looking, and was only considered when proximal attention following had been demonstrated. The longitudinal analyses revealed that at the group level, proximal attention following and checking back both emerged at 3 months. Perra and Gattis proposed that the development of proximal attention following and checking back at this age is a consequence of changes in attention disengagement that allow infants to disengage from one stimulus, whether face or target, and shift it to another.

Collectively, the findings on attention engagement and attention control thus suggest that infants are able to disengage and shift attention, as well as follow the attention of a social partner, by 3 months. We were interested in whether infants are therefore also capable of joint attention engagement at this age. Bakeman and Adamson’s study first examined attention engagement at 6 months. From 6 to 18 months, coordinated joint engagement increased, but passive joint engagement remained stable – infants spent approximately one-fifth of their time in passive joint engagement, suggesting that the latter ability was not changing during the ages in their study. We hypothesised that passive joint engagement should emerge around 3 months, the same age at which previous studies have demonstrated an increase in attention control and attention following (e.g., Butcher et al., 2000; Perra & Gattis, 2010).

We conducted a longitudinal study investigating how attention engagement changes from 2 to 4 months, and whether those changes are related to the infant's developing ability to follow the attention of a social partner. Infants were observed in a naturalistic play situation, and attention engagement was coded using Bakeman and Adamson’s engagement states. Because a subset of the infants had also participated in a measure of proximal attention following and checking back (reported in Perra & Gattis, 2010), we were able to compare engagement states with Perra and Gattis’ measure of attention control. We reasoned that if passive joint engagement is a consequence of the emerging ability to control attention, passive joint engagement with caregivers should be related to the control of social attention. Because checking back required a greater degree of attention control than proximal attention following, we focused on the relation between it and passive joint engagement. We hypothesised that passive joint engagement in play situations would be positively associated with checking back in the experimental measure of attention control.

2. Method

2.1. Participants

Forty-three infants (16 girls) were recruited through parenting classes. Infants were from a city in the UK. Seventeen additional infants participated but were excluded from analyses due to failure to attend a session or failure to complete a session due to drowsiness or crying. The study received approval from the Department of Psychology Research Ethics
Committee. Most infants (40) had both parents who identified as White-Caucasian. Infants were born full term: on average they were born 0.52 weeks after due date, with a range between 3 weeks before term and 2.6 weeks after due date. Average birth weight was 3628 g (SD = 637). Participating families received a videotape as compensation.

2.2. Design

Free play sessions were recorded monthly from 2 to 4 months. The average age of infants for each of the sessions was 62 days, 92 and 123 days for the 2-, 3-, and 4-month assessments respectively (SD was 4.0, 3.2 and 3.5 days for the sessions at 2, 3 and 4 months respectively).

2.3. Procedure

Parents and infants were welcomed to a university research laboratory by two experimenters and allowed time to familiarise themselves. Once the infant was in a calm and alert state, parents were asked to play with their child as they would normally at home, and a set of age-appropriate toys was provided. An unconcealed digital videocamera was mounted on a tripod to record the session, and a time stamp (minutes, seconds and frames) was superimposed on the recording to allow accurate time-coding. The experimenters then left the room and observed the parent–infant interactions through a monitor in the adjacent room. Due to the young age of the infants, and because the study required infants to participate in experimental sessions afterward, free play sessions were brief, lasting approximately 4 minutes. After the free play session was complete, the parent was invited to bring the infant into an adjacent room to participate in researcher-administered measures of attention and social cognition (see Perra & Gattis, 2010).

In most sessions (97%), the infant was accompanied by his/her mother. In approximately one-fifth of the sessions (24 out of 129) another adult was also present. In the majority of these cases, the other adult was the other parent, while in a few cases (5 sessions overall) it was a grandparent. The other adult present in these few cases also participated in the interaction from time to time. In a further 10 sessions an older sibling was present, but was asked to sit quietly and refrain from participating. Separate analyses revealed the same pattern of results regardless of number of family members present, so all sessions are considered together.

The parent held the child relatively close, either in their lap or on the floor in front of the parent. No specific instructions were given other than to play as they might do at home. The other adult, when present, was beside the parent holding the child, thus usually within the visual field of the infant, although not directly in front of the child. For illustrative purposes, in Fig. 1 we present a picture taken from one of the filmed sessions.

2.4. Attention engagement

Our primary aim was to characterise changes in attention engagement during early infancy. To this end, attention engagement was coded into exhaustive and mutually exclusive categories using a coding system developed by Bakeman and Adamson (1984). An overview of coding categories is provided in Table 1. Only attention states that lasted at least 3 seconds were considered in the analyses.

Infants were not considered to be in any of the six engagement states described in Table 1 if: (a) the infant’s face was not visible, (b) the caregiver intervened to calm or wake the infant, or (c) the caregiver interrupted the session because the infant had become restless or fallen asleep. A session was considered valid if an infant spent at least 2 minutes in one or more of the six attention engagement states. Periods when the infant was not alert or calm were excluded from analyses.
Table 1  
Classification of infants’ attention engagement states.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unengagement</td>
<td>Infants are not engaged in any activity in particular.</td>
<td>The infant scans the environment as though looking for something to do.</td>
</tr>
<tr>
<td>Onlooking</td>
<td>Infants attend to another persons’ activity without actively participating in it.</td>
<td>The infant observes the mother talking with a flat face; the infant observes an object the mother puts in front of him.</td>
</tr>
<tr>
<td>Person engagement</td>
<td>Infants actively interact with another person by responding to the other person or by trying to initiate an exchange.</td>
<td>The infant smiles and giggles in response to mother’s voices; infant smiles and then reaches toward the mother.</td>
</tr>
<tr>
<td>Object engagement</td>
<td>Infants play with an object alone.</td>
<td>The infant explores an object he/she has in his/her hand.</td>
</tr>
<tr>
<td>Passive joint engagement</td>
<td>Infants play with an object that is also the focus of another person’s activity but they do not acknowledge the other person’s activity.</td>
<td>The infant explores a rattle that is from time to time shaken by the mother to produce a particular noise. During this time the infant does not look back and forth between mother and the object.</td>
</tr>
<tr>
<td>Coordinated joint engagement</td>
<td>Infants play with an object that is also the focus of the other persons’ activity and acknowledge the other person’s activity by actively coordinating attention between the object and the person.</td>
<td>The infant explores manually a rattle that is from time to time shaken by the mother to produce a particular noise and during this time the infant looks at the mother and then back at the object.</td>
</tr>
</tbody>
</table>

The first author scored the videotapes of the free play sessions using a VCR with a jog shuttle. The experimenter watched the tapes in slow motion or frame by frame, reversing where necessary to identify the onset of a state change as accurately as possible. A second coder scored the sessions of 13 infants to evaluate inter-rater agreement. Percentages of overall agreement were calculated across the multi-contingency tables formed by each category of the coding system used (six engagement states, plus off-camera, and a “not reported” category to account for instances where one rater reported one category of behaviour and the other did not). We considered an agreement if the two raters reported the same category within an interval of 2 seconds. Percentages of agreement thus calculated were 64%, 73% and 80% for the sessions at 2, 3 and 4 months respectively. Overall percentages of agreement for the attention categories in the session at 2 months was low and this was due particularly to onlooking (agreement = 52%; Cohen’s k = .54) and to unengagement (agreement = 66%; Cohen’s k = .67). The agreement for all the other categories at 2 months was 71% or above, with Cohen’s k values 0.82 or above for each category. Agreement in the most essential but less frequent categories was acceptable throughout the study: Cohen’s k coefficient for person engagement was k = .86, k = .82 and k = .83 at 2, 3 and 4 months respectively; the coefficient of agreement for passive joint was k = 1.0, k = .75 and k = .85 in each session respectively and was k = .50 and k = .88 for object engagement at 3 and 4 months respectively (no instance of object engagement was coded at 2 months by both raters). Although the coefficient of agreement on object engagement at 3 months was lower, it still fell within the range of what is considered “moderate agreement” (e.g. Viera & Garrett, 2005).

2.5. Attention control

Our second aim was to examine whether changes in attention engagement were related to infant control of attention. To do so, we compared engagement states during observational sessions with caregivers to performance on an experimental measure of attention control administered at 3 and 4 months. In this procedure (reported in Perrra & Gattis, 2010), the infant was placed in an infant chair. An experimenter in front of the infant held two identical hand puppets on both sides at shoulder height. After getting the attention of the infant, the experimenter turned his head 90° towards one of the puppets and maintained this posture for at least 10 seconds. At the end of the trial the experimenter turned to the infant again. The procedure consisted of at least four trials, with turns to alternate sides (left or right) in a counterbalanced order, so that there were at least two trials for each side.

All infants participated in the experimental measure of attention control at both 3 and 4 months and 28 of the 43 had complete data for both ages. For those 28 infants, we considered two dependent measures. Infants were credited with proximal attention following when they looked to the same puppet as the experimenter. Infants were credited with checking back when, subsequent to demonstrating proximal attention following, they also alternated gaze between the experimenter and the puppet at which the experimenter was looking. Coding and reliability for these measures are reported in Perrra and Gattis (2010).

3. Results

3.1. Attention engagement

Median duration of observational sessions was 3 minutes and 56 seconds at 2 months (range 2:16 to 4:00 minutes, SD = 26 seconds), 4 minutes at 3 months (range 3:06 to 4:00 minutes, SD = 13 seconds), and 4 minutes at 4 months (range
2:56 to 4:00 minutes, SD = 11 seconds). To adjust for differences in session length, aggregate duration of each engagement state was divided at each age by the total duration of the session excluding periods of adult intervention and off-camera.

3.1.1. Distribution of engagement states across all ages

In this section we give an overview of the time spent by infants in each engagement state, aggregating percentages of time across the three age points. These percentages are reported in Fig. 2.

Across all ages, the two most common states were unengaged and onlooking. Infants spent 42% of the time unengaged, and 37% of the time onlooking. Infants spent 9% of the time in passive joint engagement, 6% of the time in person engagement, and 6% of the time in object engagement. Not surprisingly, coordinated joint engagement was not observed in any infant at any of the ages tested.

3.1.2. Distribution of engagement states at each age

Dramatic changes were observed in the proportions of time spent in each engagement state across age. Proportions of time spent in each state by age are reported in Table 2.

Unengagement, the most common state at 2 months, decreased significantly between 2 and 4 months, $F(2, 84) = 32.42, p < .001$. Post hoc tests (Bonferroni) confirmed that the proportion of time spent unengaged decreased significantly between 2 and 3 months and also between 3 and 4 months. Significant increases were observed in the amount of time spent in object engagement $F(1, 42) = 29.37, p < .001$, and passive joint engagement $F(1, 42) = 33.92, p < .001$. Post hoc tests (Bonferroni) revealed the relative amount of time spent in passive joint engagement increased significantly between 2 and 3 months and also between 3 and 4 months. Time spent in object engagement increased significantly between 3 and 4 months. In contrast, onlooking and person engagement did not vary significantly across the developmental period considered, $F(2, 84) = 2.36, p = .10$ and $F(1, 42) = 0.32, p = .57$ respectively. Overall, therefore, the age-related decrease in unengagement corresponded to an increase in passive joint engagement, and, somewhat later, an increase in object engagement.

Correlations between proportions of time spent in each engagement state suggested that attention states clustered in significant ways, with the most meaningful relations occurring at 3 and 4 months. Longitudinal correlations for each type of engagement state and cross-sectional correlations within age are reported in Table 3.

Cross-age correlations indicated some stable individual differences in attention engagement. Relative duration of person engagement episodes at 3 months was positively related to duration of the same state at 4 months. Significant positive

### Table 2

<table>
<thead>
<tr>
<th>State</th>
<th>2 months</th>
<th>3 months</th>
<th>4 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unengagement</td>
<td>60.03</td>
<td>42.31</td>
<td>24.57</td>
</tr>
<tr>
<td>Onlooking</td>
<td>32.90</td>
<td>42.32</td>
<td>36.70</td>
</tr>
<tr>
<td>Person engagement</td>
<td>6.63</td>
<td>5.21</td>
<td>5.53</td>
</tr>
<tr>
<td>Object engagement</td>
<td>0.00</td>
<td>2.47</td>
<td>15.28</td>
</tr>
<tr>
<td>Passive joint engagement</td>
<td>0.44</td>
<td>7.69</td>
<td>17.92</td>
</tr>
</tbody>
</table>
relations were also observed between relative duration of passive joint engagement at 2, 3 and 4 months, suggesting that despite the increase in the duration of this state, individual differences remained stable.

Cross-sectional correlations between engagement states revealed that time spent in person engagement was negatively related to the duration of passive joint engagement, suggesting that infants who spent more time engaged with social partners were less inclined to engage in passive joint episodes for long periods. In contrast, time spent in passive joint engagement was positively related to that of object engagement at 3 and 4 months. Thus at 3 and 4 months passive joint engagement clustered with object engagement, but was negatively related to person engagement at these same time points. Principal component analyses at 3 and 4 months confirmed this clustering of states.

3.1.3. Age of emergence for engagement states

To further investigate developmental relations and inter-individual differences between attention engagement states, we considered the age of emergence for each engagement state. For each infant, the age of emergence for an engagement state was defined as the first monthly session in which the infant displayed that state at least once. In Table 4 we report the number of infants demonstrating the onset an engagement state at 2, 3 or 4 months.

Table 4
Frequencies of onset of each engagement state by age. Cumulative percentages report the aggregate percentage of infants that had displayed the engagement state by each age or before.

<table>
<thead>
<tr>
<th>Engagement State</th>
<th>2 months</th>
<th>3 months</th>
<th>4 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unengagement</td>
<td>42</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>%</td>
<td>97.7</td>
<td>2.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>97.7</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Onlooking</td>
<td>41</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>%</td>
<td>95.3</td>
<td>4.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>95.3</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Person engagement</td>
<td>26</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>%</td>
<td>60.5</td>
<td>16.3</td>
<td>4.7</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>60.5</td>
<td>76.8</td>
<td>81.5</td>
</tr>
<tr>
<td>Object engagement</td>
<td>0</td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td>%</td>
<td>0.0</td>
<td>23.3</td>
<td>53.5</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>0.0</td>
<td>23.3</td>
<td>76.8</td>
</tr>
<tr>
<td>Passive joint engagement</td>
<td>5</td>
<td>22</td>
<td>12</td>
</tr>
<tr>
<td>%</td>
<td>11.6</td>
<td>51.2</td>
<td>27.9</td>
</tr>
<tr>
<td>Cumulative %</td>
<td>11.6</td>
<td>62.8</td>
<td>90.7</td>
</tr>
</tbody>
</table>
The majority of infants displayed unengagement and onlooking in the first session of the study at 2 months. Although person engagement was displayed for relatively short periods of time across sessions (as reported in Table 2), the majority of infants (60%) displayed person engagement from the beginning of the study at 2 months. Only nine infants (21%) displayed person engagement for the first time at a later age. Passive joint engagement and object engagement emerged later than person engagement. For the majority of participants (51%) passive joint engagement emerged at 3 months: there was a significant increase in the cumulative number of infants that had engaged in passive joint attention by 3 months compared to age 2 months ( McNemar’s test, \( p < .001 \)). A further significant increase in passive joint engagement was observed between 3 and 4 months ( McNemar’s test, \( p < .001 \)). Object engagement emerged later than passive joint engagement: 54% of the infants displayed object engagement for the first time at 4 months, a significant increase from 3 months ( McNemar’s test, \( p < .001 \)). Thus overall, most infants displayed person engagement by 2 months, passive joint engagement at 3 months, and object engagement at 4 months.

To further investigate relationships between and individual differences in engagement states, we analysed the precursor relationships between the onset of these abilities using Bart and Airasian’s ordering-theoretic method (Bart & Airasian, 1974). The rationale of this method resides on the assumption that if ability \( i \) is the prerequisite of ability \( j \), a pattern whereby \( i \) is absent and \( j \) is present should be observed less often than a fixed tolerance level (usually no more than 5% of participants displaying this ‘disconfirmatory’ response pattern). In this analysis we considered the number of infants displaying a given state (e.g. person engagement) before the onset of another state (e.g. object engagement). The matrix of patterns of onset for engagement states is shown in Table 5, while in Fig. 3 we graphically represent the relationships between engagement states supported by this analysis.

### 3.2. Relation between attention engagement and attention control

To examine the relation between attention engagement and attention control, we considered the performance of 28 infants from the observational study who also had complete data for the experimental measure of attention control at 3 and 4 months (reported in Perra & Gattis, 2010). We first investigated predictive relations between passive joint engagement in the observational sessions and checking back in the experimental sessions. Spearman’s correlations indicated that the amount of time spent in passive joint engagement at 2 months predicted the relative frequency of checking back displayed.
by infants at 3 months ($\rho = 0.33, p = .046$, one tailed test). The relationship between passive joint engagement at 2 months and checking back at 4 months was also positive, but small and not significant ($\rho = 0.05, p = .40$, one tailed test).

We then examined the relationship between stability of passive joint engagement attention and checking back, with the hypothesis that infants consistently demonstrating this state by 4 months should perform better on the experimental measure of social attention control. We divided infants into two groups according to the stability of time spent in passive joint engagement during the 3- and 4-month sessions: stable passive joint engagement was defined as spending just as long or longer in passive joint engagement at 4 months as the previous month, while unstable passive joint engagement was defined as spending less time in passive joint engagement at 4 months than the previous month. Infants with stable passive joint engagement showed more checking back compared to infants with unstable passive joint engagement: infants with stable passive joint engagement checked back on 51.6% of experimental trials at 4 months, whereas infants with unstable passive joint engagement checked back on 30% of trials at 4 months $t(24) = 1.77, p = .048$ one tailed.

4. Discussion

We conducted a longitudinal study investigating developmental changes in attention engagement from 2 to 4 months. Although changes in visual attention are thought to be among the most significant areas of development in early infancy, and Bakeman and Adamson’s (1984) categories of attention engagement have become foundational constructs in developmental psychology, to our knowledge, no study has used Bakeman and Adamson’s method to investigate how attention engagement develops before 6 months. Our study applied Bakeman and Adamson’s method to younger infants, and compared attention engagement in naturalistic settings to attention control in an experimental setting. We were particularly interested in the emergence of passive joint engagement, and hypothesised that passive joint engagement is a consequence of emerging attention control, and would predict performance in a more demanding experimental context.

Our first analyses focused on identifying engagement states at each of the ages observed from 2 to 4 months. The results indicated a developmental transition in attention engagement at 3 months. From 3 months onward, infants engaged both for longer periods and in a wider variety of states. At 2 months infants spent most of the time unengaged or onlooking, but did sustain face-to-face person engagement for short periods of time. At 3 months infants spent significantly more time in passive joint engagement, and the majority of infants first demonstrated it at this age. At 4 months the time spent in passive joint engagement again increased significantly, and object engagement emerged, with a significant increase in the amount of time spent playing with objects and a significant increase in the number of infants displaying this state for the first time. Our results demonstrate that infants are capable of passive joint engagement in the first months of life. Our interpretation focuses on infants’ capabilities for attention engagement, not on the representativeness of engagement levels, because the interactions we recorded were brief. The durations of interactions in our study were however comparable to other studies of interactions at this age (e.g., Lavelli & Fogel, 2005).

Our results extend the findings of Bakeman and Adamson (1984), who reported that passive joint engagement is consistent from 6 to 18 months. We found that passive joint engagement increased from 2 to 3 months and again from 3 to 4 months. At 4 months, the infants in our study spent approximately the same amount of time in passive joint engagement as the infants in Bakeman and Adamson’s study, indicating that after emerging at 3 months, the state quickly reaches asymptote.

The results of our longitudinal analyses also highlight relations between engagement states. Person engagement, the focus of many studies of early social interactions (e.g., Hsu, Fogel, & Messinger, 2001; Lavelli & Fogel, 2005; Markova & Legerstee, 2006), showed an independent developmental pathway compared to passive joint and object engagement, as illustrated in Fig. 3. Passive joint engagement was a pre-requisite for object engagement: the onset of passive joint engagement consistently preceded the onset of object engagement. This relation appears to reflect the limited prehensile skills of infants during the first months of life (see Van Hofsten, 2004): passive joint engagement allows for caregivers to hold and manipulate objects, but object engagement requires that infants manipulate objects themselves. The relations between passive joint engagement and object engagement thus suggest that parents play an important role in introducing infants to the world of objects before they are able to reach and manipulate objects themselves, and more generally highlight the importance of social context in attention engagement and joint attention (Gaffan, Martins, Healy, & Murray, 2010; Keller, Otto, Lamm, Yovsi, & Kärtnner, 2008; Racine & Carpendale, 2007; Tremblay & Rovira, 2007). We suggest that passive joint engagement plays a transitional role, both developmentally and episodically. During passive joint engagement, an infant is able to capitalise on the social environment by attending to objects offered by others. This state can then allow the infant to explore alone, once the social partner withdraws, or to engage with both the object and the social partner more fully, once the infant is capable of coordinated joint attention.

Previous studies have characterised the relation between person engagement and object engagement as one focus giving way to the other over time (e.g., Kaye & Fogel, 1980). Our results show a different relation: across the ages studied, person engagement was negatively related to passive joint engagement and object engagement. Person versus object engagement may reflect longer-lasting individual differences. Future research might investigate the source of these differences, in particular whether they arise from parental preferences, infant preferences, or some interaction between the two. A second interesting question for future research is whether these differences are transient or lead to other, subsequent differences in behaviour. Similarly, future analyses may also benefit from considering the quality and quantity of parental input during interactions (e.g. time spent in face-to-face games) and how they relate to infant attention engagement longitudinally.
The attention engagement states with caregivers reported here are consistent with recent experimental evidence that infants begin to follow the attention of social partners around 3 months (Gredebæk et al., 2010; Perra & Gattis, 2010). Our design allowed us to test whether passive joint engagement is related to attention control, by comparing attention engagement during observational sessions to performance on an experimental measure of attention following and checking back (reported in Perra & Gattis, 2010). Although these analyses involved a smaller sample of infants who had complete data for both measures, we found a significant positive relation between passive joint engagement and checking back. Future research is needed to investigate this relation with a larger sample and more extended observations to allow for a fuller assessment of this important question.

In conclusion, attention engagement changes dramatically in early infancy, with passive joint engagement emerging at 3 months. Passive joint engagement observed in caregiver interactions appears to reflect a general development in attention control, indicated by a positive relation between passive joint engagement in observational sessions and attention control in an experimental measure. This study thus lays a foundation for future research investigating the influence of both infant and caregiver on the emergence of attention control.

Acknowledgments

The research reported here was supported by Grant R000223638 from the Economic and Social Sciences Research Council of the United Kingdom to both authors and a Scholarship for Studies in Biological and Medical Sciences in Foreign Institutions awarded (Pos. 204.5073) by the Italian Research Council (Consiglio Nazionale delle Ricerche) to Oliver Perra. Oliver Perra was supported by an ESRC Post-doctoral Fellowship (PTA-026–27–1097) at Cardiff University while working on this manuscript. This research was conducted at the University of Sheffield. We thank all the parents and infants who participated, Caren Fosch for her many contributions to this work, including coordinating the testing, Raffa Carta and two placement students for coding. We also thank Dale Hay for helpful comments and discussion.

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