Can infants' orientation to social stimuli predict later joint attention skills?

Abstract

From the moment infants are born, they seem to prefer orienting to social stimuli, over objects and nonsocial stimuli. This preference lasts throughout adulthood and is believed to play a crucial role in social-communicative development. By following up a group of infants at the age of 6, 8, and 12 months, this study explored the role of social orienting in the early development of joint attention skills. The expected association between social orienting and joint attention was partially confirmed. Social orienting in real life photographs of everyday situations was not related to later joint attention skills, however fixation to the eyes in a neutral face was related to response to joint attention skills, and fixation to the eyes in a dynamic video clip of a talking person was predictive of initiating joint attention skills. Several alternative interpretations of the results are discussed.

From the first moment infants start to visually take in the world, they seem to prefer looking at other people, more than to other stimuli in the environment. Numerous studies have demonstrated that infants are showing an innate preference to orient to all sorts of social stimuli, such as faces, eyes, and voices (e.g., Cassia, Valenza, Simion, & Leo, 2008; Farroni et al., 2005; Lozonczy, 2004; Morton & Johnson, 1991). This tendency to orient to social stimuli is believed to be very important in social development, and it is demonstrated to last throughout life (e.g., Fletcher-Watson, Leekam, Benson, & Findlay, 2009). The explanation for this tendency has, amongst others, been searched for in studies on early visual processes (e.g., Farroni et al., 2005; Frank, Vul, & Johnson, 2009; Simion, Leo, Turati, Valenza, & Barba, 2007). There is for example some support for a link between contrast sensitivity and the preference to look at faces (Farroni et al., 2005). Neurological evidence has been found for the involvement of an early magnocellular system that is sensitive to low spatial frequency stimuli and luminance contrast. This system influences early visual experience, leading infants to orient to social stimuli (Plaisted & Davis, 2005). In addition, social stimuli are believed to have an inherent positive rewarding value through the development of a specific motivational system (Mundy & Sigman, 2006) mediated by neural mechanisms.

In many studies, social orienting has been investigated as the orientation of attention in response to a social cue (e.g., following the eye gaze of another person, responding to name calling). However, in this study, the approach of Birmingham and Kingstone (2009) is followed, who propose that the study of the selection of the cue (orienting to social stimuli) is as important as the reaction to the cue itself. After all, if infants do not actively orient towards social stimuli in the first place, they are not able to pick up the meaning of social cues and will fail to respond appropriately when confronted with one.

Social orienting is expected to be related to social-communicative skills, such as joint attention, which involves the triadic coordination between the infant, another person, and an object or event (Adamson, 1995; Mundy, Sigman, & Kasari, 1994). These triadic interactions, with a developmental start very early in life and clearly present around the age of 9 months (Bruinsma, Koegel, & Koegel, 2004, Striano & Bertin, 2005), are believed to build on earlier forms of dyadic engagements (Striano & Rochat, 1999). Active attention to social stimuli would therefore be a crucial step in this development, since it leads to more opportunities to engage in social interactions, in which children can learn about social-communicative skills. Moreover, the motivational system that leads to the rewarding value of social stimuli, is also believed to be the reason why children participate in triadic interactions. It seems plausible that the preference to orient socially could vary between children and that it has a predictive value for the development of social and communicative abilities, such as joint attention skills (Maestro et al., 2002).

In children with social impairments, such as children with autism, a lacking tendency to orient towards social stimuli has been proposed as one explanation for their difficulties with joint attention skills (Maestro et al., 2005; Mundy & Burnette, 2005). Some studies have found support for this association (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Dawson et al., 2004). However, it must be noted that in these studies social orienting was defined as the attentive reaction towards a social cue, rather than the voluntary attention to social stimuli.

In typical development, little is still known about the nature of individual differences in infants' joint attention skills (Mundy et al., 2007; Mundy & Newell, 2007). The link between social orienting and joint attention has been suggested multiple times, but is seldom investigated in typical development. The social preference of young infants is irrefutably demonstrated, as is the pivotal role of joint attention in development. However, the association between them is yet to be understood. Therefore, this longitudinal study will try to shed some light on the role of social orienting in the development of joint attention, by following up a group of typically developing children at the ages of 6, 8, and 12 months. The focus will be on social orienting as a voluntary attentional process, measured in a precise way, with as high ecological validity as possible. An eye-tracking device is used to present photographs of real life situations, more detailed photographs of close up faces, and a video clip of a person talking to the child. In other studies, static and dynamic stimuli are seldom investigated together, sometimes leading to conflicting results, since both types of stimuli are assumed to be processed in a different way (Shaddy & Colombo, 2004; Lewcowicz, 2008). This study is one of the first to explore attention orienting towards different types of social stimuli in young infants, and to investigate the link with later joint attention skills. Response to joint attention skills are assessed at the ages of 8 and 12 months, and initiation of joint attention skills are assessed at the age of 12 months. The individual differences in both response to, and initiation of joint attention skills are expected to be predicted by the individual differences in social orienting at the age of 6 months.

Method

Participants

Typically developing infants were recruited through birth lists provided by a governmental health office. Initially, thirty-one children (14 males, 17 females) participated at the age of 6 months (M = 182 days, SD 6.35), but due to drop out, this number was reduced to thirty children at the age of 8 months (M = 250 days, SD 12.22), and twenty-eight children at the age of 12 months (M = 370 days, SD 10.00). Parents gave their written consent for participation and the children received a small reward after each session. The relatively small sample size of 31 in this study implicated that a moderate power of .50 was reached when correlations were .35 or higher and that a high power of .80 was reached when correlations were .47 or higher.

General procedure

Parents were asked to come to the university at a moment on which they expected their child to be awake and alert for about one hour. Before starting, the children were given some time to get used to the new environment. At the age of 6 months, three social attention tasks were conducted. The Mullen Scales of Early Learning (MSEL; Mullen, 1995) was administered during a visit at 8 months of age. Next to a composite score, the MSEL yields percentile scores for five domains, including receptive and expressive language abilities. A relatively easy response to joint attention task was also conducted at this age. At the age of 12 months, both response to joint attention skills, and initiation of joint attention skills were assessed.

Apparatus & Stimuli

The social attention tasks were conducted by means of a Tobii T60 Eye Tracker (Tobii Technology, Sweden), with a 17-inch display, maximum resolution of 1280 x 1024 pixels, and data rate of 60 Hz. Children were sitting on their parents' lap, approximately 60 cm away from the screen. Visual distraction was minimized 180° around the eye tracker.

For the first social attention task, five full-screen coloured photographs of a realistic everyday situation (Realistic photographs) containing social stimuli, were presented. The social stimuli on average covered 24.43 % of the photographs and faces on average covered 8.01 % of the photographs. In order to increase ecological validity, it was important to present the social stimuli in a naturalistic context, where they have to compete with other visual input (Fletcher-Watson et al., 2009). Therefore, the photographs also contained nonsocial stimuli (e.g., toys, food), about equally eye-catching as the social stimuli, and covering on average 23.59 % of the photographs. An example of a photograph can be found in Appendix A.

For the second social attention task, two photographs of close up face portraits were used, one of a female face with neutral expression (Neutral face) and one of a female face smiling (Smiling face). These photographs were in portrait orientation (27 x 21 cm). In both faces, a contrast was present in the eyes between the light colouration of the sclera versus dark coloured irises. In the Smiling face, there was an additional contrast in the mouth, between the white teeth and red lips.

The third social attention task consisted of a full screen video clip showing a female person surrounded by four colourful toys (e.g., a toy phone) in the background, addressing the child gently, by talking, nodding, and smiling, as she would normally do in interaction with an infant. A snapshot can be found in Appendix A.

Measures

Social attention tasks. In the first social attention task (*social preference task*), five Realistic photographs were presented successively on the eye tracker, lasting 10 seconds each. In Tobii Studio Software, areas of interest were placed around the social stimuli in the photographs and eye gaze data of the children were analyzed automatically. Variables of interest were (1) the observation length of social stimuli and of faces, relative to the total observation time, since not all children looked at the photographs equally long, and (2) the mean latency time to the first fixation on a social stimulus. This latency time reflects to what extent the social stimuli receive attentional priority.

In the second social attention task (*face scanning task*), the Neutral face and the Smiling face were presented successively on the eye tracker and lasted 10 seconds each. Rectangular areas of interest were fitted to the left, right, lower, and upper outside edges of the eyes and mouth of each stimulus face. Of interest was the observation length of the eyes and the mouth for both faces, relative to the total observation time.

The third and last social attention task (*social attention in dyadic engagement*) consisted of a video clip of a female person, presented on the Tobii T60 eye tracker, and lasting 35 seconds. Outcome variables were observation length of the face, of the nonsocial objects, and of the eyes and mouth, relative to the total observation time.

Joint attention - Response to joint attention. Responding to joint attention (RJA) was evaluated at 8 months and 12 months of age. At the age of 8 months, a gaze following task was conducted with the child seated in an infant seat, placed on a table, with two toy ducks placed to the left and the right, at eye level of the child, and within the visual field. The experimenter was standing with her face approximately 40 cm away from the face of the child. After getting the attention of the child and when eye contact was established, the experimenter turned her head and eyes towards one of the target objects for about 10 seconds, while talking enthusiastically about the toy. This was done alternately twice for each target. To receive credit, the child had to look at the target during the attempt of the experimenter. Scores ranged from 0 (no gaze following) to 4 (gaze following in all four attempts). The intra-class correlation coefficient was computed across two independent coder ratings of all children and was very good (ICC = .96).

At the age of 12 months, four pictures were placed on the walls to the infant's left, right, left behind, and right behind (see Figure 1). The pictures were brightly coloured figures of Winnie the Pooh and friends®, they were 50 cm long and 40 cm wide. After making eye contact with the child, the experimenter attempted to direct the child's attention towards each of the four posters by gazing towards them, in a predetermined order. If the child did not respond, a verbal prompt and a pointing behaviour were added. To receive credit, the child had to look at the target during or within three seconds after the attempt of the experimenter. Children received a RJA level score, ranging from 0 to 4 (0 = no following, 1 = point following towards a target in the front, 2 = gaze following towards a target in the front, 3 = point following towards target behind them, 4 = gaze following towards target behind them). This order in degree of difficulty was supported by the collected data, based on the number of children who reached a certain level. Interrater reliability was determined by double coding of 50% of the observations and was very good (ICC = .94). Whereas the score on the response task at the age of 8 months relied on the frequency of attention following, the focus at 12 months was more on the quality of response to joint attention skills.

INSERT FIGURE 1 HERE

Joint attention - Initiation of joint attention. Because the context in which joint attention skills are observed can have an influence on the performance of children (Roos, McDuffie, Weismer, & Gernsbacher, 2008), two different tasks were used to elicit initiations of joint attention, in order to obtain a more extensive picture of the IJA skills.

Basic initiation of joint attention skills (Basic IJA) were observed at the age of 12 months, using different toys. Basic IJA skills were elicited within a structured interaction, with the focus of both child and experimenter already on the objects of interest. Following Mundy et al. (2007), the frequency of the following IJA behaviours was observed: 1) making eye contact with the examiner while manipulating a toy, 2) alternating eye contact between an active mechanical toy and the tester, 3) pointing to an active mechanical toy with or without eye contact, and 4) showing by raising objects toward the tester's face with eye contact. The former two were combined into a *Basic IJA low* score, the latter two were combined into a *Basic IJA high* score. The *Basic IJA* score reflected the total frequency of all four behaviours. Coding was carried out using The Observer 8.0, a program designed for observing and analyzing observational data (Noldus, 2003). Inter-rater reliability was determined by double coding of 20% of the observations and the intra class coefficient for the total Basic IJA score was .76.

The initiation of joint attention was also elicited by confronting children with an unexpected positive event. While children were playing on a carpet with some toys, facing the experimenter, three video clips of 30 seconds each (with 60 seconds in between) appeared on a television screen behind the experimenter. The video clips were accompanied by sounds to attract attention and respectively showed a monkey jumping up and down, a car passing by several times and a mouse waving. The number of joint attention behaviours initiated by the child was measured (*Event IJA*), and divided into *Event IJA low*, expressing the number of eye contact and alternates, and *Event IJA high*, expressing the number of pointing behaviours (cfr. Basic IJA scores). The intra-class correlation coefficient for Event IJA was computed across two independent coder ratings of all children and was very good (ICC = .91). Where Basic IJA concerned a triadic coordination about an object already within the interaction, in this task, the object of interest was outside the interaction. In both tasks, the initiation of joint attention is considered to be socially motivated.

In order to be able to compare the reactions of children over the different IJA tasks, the duration of the tasks was taken into account, resulting in IJA scores expressed as behaviours per minute. It was also observed whether or not children showed the highest level of IJA (coordinated pointing) in at least one of the IJA tasks.

Results

Due to drop out, data were missing in one child at 8 months and in three children at 12 months. Reasons for drop out were illness during the time period of examination and parents' lack of time. Besides this attrition, data of some infants were missing at the age of 6 months (*N* = 1 (face scanning neutral face)), at the age of 8 months (*N* = 1 (RJA)), and at the age of 12 months (*N* = 3 (RJA); *N* = 1 (event IJA)) due to fussiness, crying, or technical problems. The reasons for the missing data made us conclude that the missingness was completely at random (MCAR; Schafer & Graham, 2002). Moreover, Little's MCAR test (Little, 1988) was not significant (χ^2 = 476.27, *ns*), confirming that the pattern of missingness was indeed completely at random. Therefore, missing values were estimated using the Expectation-Maximization (EM) algorithm (Dempster, Laird, & Rubin, 1977), based on all available data of the children at the three time points.

Assumptions for parametric tests were not met for the RJA level scores and the language scores in the MSEL. Therefore, non-parametric analyses were used when these variables were involved.

Social attention tasks at 6 months

Social preference task with realistic photographs. During the presentation of the photographs, children on average looked 52.47 % (*sd* 14.03) of their observation time at social stimuli, of which more than 75 % was at faces. A paired t-test compared the percentage of looking time at social stimuli with the percentage of looking time at nonsocial stimuli (24.06%, *sd* 13.24). The t-test was significant ($t(30) = 6.22$, $p < .001$). The mean latency to the first look at a social stimulus was 1.87s (*sd* 1.02).

Face scanning task. In the neutral face, children on average looked 77.78 % (*sd* 20.57) of the observation time at the eyes, and 4.46 % (*sd* 6.68) at the mouth region. In the smiling face, children on average looked 50.30 % (*sd* 27.69) of the observation time at the eyes of the presented faces, and 23.51 % (*sd* 26.23) at the mouth region. For both faces, this difference was significant (respectively $t(30) = 16.28$; $p < .001$ and $t(30) = 2.97$; $p < .01$) (see Figure 2). A repeated measures analysis showed that there was a significant interaction effect between face and attended region ($F(1,30) = 20.16$; $p < .001$). In the smiling face, the difference between the percentage of looking time at the eyes and the mouth, was significantly smaller than in the neutral face.

INSERT FIGURE 2 HERE

Social attention in dyadic engagement. When presented with a video clip of a female person surrounded by attractive nonsocial stimuli (toys), children on average looked 78.44 % (*sd* 17.68) at the face, 13.25 % (*sd* 13.49) at the nonsocial stimuli, 13.53 % (*sd* 17.63) at the eyes, and 35.84 % (*sd* 24.11) at the mouth (see Figure 3). Children looked significantly longer at the face of the person, than at the nonsocial stimuli surrounding her ($t(30) = 11.92$; $p < .001$). A second paired t-test revealed that children on average looked significantly longer at the mouth than at the eyes ($t(30) = -3.41$; $p < .01$).

INSERT FIGURE 3 HERE

Social orienting variables that were expected to relate to joint attention skills were (1) percentage of looking time at social stimuli in the realistic photographs, (2) mean latency time to the first look at social stimuli in the realistic photographs, (3) percentage of looking time at the eyes in the neutral face, (4) percentage of looking time at the eyes in the smiling face, (5) percentage of looking time at the person talking, and (6) percentage of looking time at the eyes of the person talking. For an overview of the intercorrelations between the social orienting variables, see Table 1. There were no significant correlations between any of these social orienting variables and the MSEL developmental index, or the MSEL language scores, measured at the age of 8 months.

INSERT TABLE 1 HERE

Response to Joint Attention

In the gaze following task at 8 months, 84 % of the children was able to follow the gaze of the experimenter to at least one target. Six children were able to follow gaze in all four attempts. There was no significant correlation between the RJA score at 8 months and the MSEL developmental index (ρ = -.01; *ns*), the MSEL receptive language score (ρ = -.11; *ns*), or the MSEL expressive language score (ρ = -.02; *ns*).

In the gaze following task at the age of 12 months, 87.10 % of the children was able to follow a gaze when regarding the targets in the front. When pointing was added, an additional 9.68% of the children was able to find these targets. For the targets behind them, 32.26 % of the children was able to follow gaze, and an additional 19.35 % of the children was able to find these targets when pointing was added. There was no significant correlation between the RJA level score at 12 months and the MSEL developmental index

(ρ = - .19; *ns*), the MSEL receptive language score (ρ = -.25; *ns*), or the MSEL expressive language score (ρ = .01; *ns*).

The RJA skills at the age of 8 months were significantly related to the RJA level score at the age of 12 months (ρ = .37; $p < .05$).

Initiation of Joint Attention

As a reaction to objects within a structured interaction, children of 12 months on average initiated two joint attention behaviours per minute, and as a reaction to an unexpected positive event outside the interaction, children on average initiated five joint attention behaviours per minute. Ten children showed the highest level of IJA (pointing combined with eye contact). They did not show a higher developmental index ($t(29) = .53$; *ns*), higher receptive language scores (*Mann Whitney U* = 92.00; *ns*), or higher expressive language scores (*Mann Whitney U* = 88.50; *ns*) than children who did not.

There was a significant positive correlation between Basic IJA and Event IJA (r = .47; $p < .01$). As the IJA behaviours in the two tasks (Basic IJA and Event IJA) were assumed to reflect the same behaviour with the same underlying social motive, elicited in a different way, composite measures for IJA were computed as the mean of Basic IJA and Event IJA, resulting in three scores reflecting the IJA behaviours of the children: IJA, IJA low and IJA high (see Table 2).

INSERT TABLE 2 HERE

No significant correlations were found between MSEL developmental index and IJA, IJA low or IJA high. Also no significant correlations were found between the IJA scores and the MSEL language scores. The total IJA score correlated marginally significantly with the RJA score at the age of 8 months (ρ = .33, p < .10), and correlated significantly with the RJA level score at the age of 12 months (ρ = .36, p < .05).

Prediction of joint attention skills

Response to joint attention. Correlations between the social orienting variables and RJA skills of children were almost all low and nonsignificant, except for the percentage of time children looked at the eyes in the neutral face. This was significantly related to the RJA skills at 8 months of age (ρ = .38, p < .05), and almost significantly related to the RJA skills at 12 months of age (ρ = .35, p = .054). For an overview of the correlations, see Table 3.

Initiation of joint attention. Only one significant correlation was found between the social orienting variables and IJA skills of children. The percentage of looking time at the eyes in the video clip task was significantly related to the initiation of joint attention by means of eye contact and alternates (IJA low) (r = .36; p < .05), and was marginally significantly related to the total IJA score (r = .31; p < .10). For an overview of the correlations, see Table 3.

INSERT TABLE 3 HERE

As for the level of joint attention, children who showed the highest level (coordinated pointing) did not show higher social orienting scores on any of the tasks than children who did not.

Discussion

Although it is assumed that social orienting in young children is important for social development, this relationship is rarely investigated in typical development. By following up a group of typically developing children from 6 to 12 months of age, this study tried to explore the role of attention for social stimuli in the development of joint attention skills.

Social orienting

While visually exploring photographs of real life situations, children showed a clear tendency to look at the persons and their faces in the photographs. When presented with two static close up face portraits, children looked most at the eyes of the persons. The smaller difference between the preference for eyes and mouth in the smiling face, where the contrast in the mouth seems to draw the attention of the children as well, supports the idea that this preference is, at least partially, based on contrast polarity. Another possible explanation for the stronger preference for the mouth in the smiling face is that in this way children try to gain information about the emotional expression in the face, since happiness is believed to be best identified from mouth information (Bassili, 1979; Calder, Young, Keane, & Dean, 2000). When watching a dynamic stimulus of a talking person, it was very obvious that children preferred to look at this person's face rather than the toys surrounding her. Within the face, children preferred to look at the mouth of the person, rather than at the eyes. Although we also expected to find a preference for the eyes in this task, an explanation for the tendency of the children to look at the mouth is quite easy to find. The mouth in this task was not only showing a contrast between the lips and teeth, but it was also a dynamic stimulus, which children at this age find very attractive (Shaddy & Colombo, 2004). Moreover, as this task contained auditory information, infants were probably also looking at the mouth in order to utilize the visual information to optimize perception of speech. This may be facilitating for their language development (Lansing & McConkie, 2003; Young, Merin, Rogers, & Ozonoff, 2009). This hypothesis is supported by a relationship between the percentage of looking time at the mouth and language understanding at the age of 8 months ($\rho = .41$; $p < .05$).

Although the tendency to orient to social stimuli was very clearly observed in the typically developing children as a group, there were large individual differences in all the social orienting variables. Findings within the social orienting tasks were in line with the literature, and in addition intercorrelations between the different social orienting tasks were significant. As such, this suggests that we were truly measuring the tendency of children to look at social stimuli. Since this tendency is assumed to reflect an underlying social motivation of children and to help children develop social-communicative skills by creating more opportunities to learn about social cues, it was expected that these individual differences would be predictive of joint attention skills at a later age. Social orienting is regarded as a factor that contributes to joint attention development, but it is not expected to explain joint attention development in its entirety. Our expectations were partially confirmed.

Response to joint attention

At the age of 8 months, a large number of children was able to follow the gaze of the experimenter towards a target object within their visual field. This skill was however still developing strongly, which was reflected in large individual differences in the number of successful trials between children. Also in the RJA task at the age of 12 months, large individual differences were found, which could not be explained by the cognitive abilities of children. Although the RJA tasks at both ages used different types of scores (frequency versus quality), they expressed individual differences and were interrelated, supporting the validity of both measures. In line with previous studies (e.g., Morales et al., 2000), the significant correlation between both tasks indicates stability of RJA skills over time.

It was surprising that correlations between most of the social orienting variables and RJA skills were so low. For instance, it was expected that RJA skills would be strongly related to the preference for social stimuli in photographs of real life situations, based on the assumption that children who orient more often to other people create increased opportunities to learn about gaze following. However, this hypothesis was not confirmed. Given the relatively small sample size, the possibility that correlations may have been obstructed due to reduced power should be considered. Moreover, it is rather difficult to reliably measure behaviour in young infants (Singer, 2001).

One could wonder whether it is sufficient to look at social cues when presented with a direct opportunity (probably mostly dependent on visual characteristics), and less necessary to actively seek for them (probably more dependent on the underlying social motivation of children and reflected in the social orienting in realistic photographs). A closer inspection of the data reveals that children with the lowest social preference scores on all social orienting tasks did not show notably poorer RJA skills. Even the children with the lowest tendency to orient socially showed appropriate RJA skills at the ages of 8 and 12 months. Perhaps it does not matter how much of their time children are actively looking at social stimuli in their environment, as long as they do this sufficiently often.

However, we found some support for the idea that children who are more attentive for social cues and therefore have more experience with them, are advantaged in their social-communicative development. Looking time at the eyes in the neutral face at the age of 6 months could predict RJA skills at the age of 8 and 12 months. Children attending the eyes of another person more often, may have increased learning experiences with eye gaze cues being followed by an interesting object or event. It must be noted that the looking time at the eyes in the neutral face was the only social orienting variable predictive of RJA skills and that it was also not related to the other social orienting variables. One might wonder what it is about this variable that makes it different from the other variables and explains its relationship with RJA skills. It is peculiar that this static stimulus of a neutral face is the only stimulus that yields meaningful individual differences in predicting RJA skills since the eyes are really the only interesting area to look at in this face. Future research should investigate these different kinds of stimuli more in depth. Nevertheless, the finding that a rather brief measure of social orienting at the age of 6 months related to RJA skills at both 8 and 12 months, presents reasonable support of the hypothesized contribution of social orienting to the development of responding to joint attention, especially given the methodological challenges of behavioural measures in infant research.

Initiation of joint attention

At the age of 12 months, children used more eye contact and alternates to initiate joint attention than pointing behaviours. Their IJA skills were not related to their cognitive development. Although RJA and IJA skills are believed to be mostly independently developing skills with unique processes involved (Mundy, Sullivan, & Mastergeorge, 2009; Slaughter & McConnell, 2003; Striano & Bertin, 2005; Striano, Stahl, & Cleveland, 2009), this study found some support for common processes as well, as some significant correlations were found between RJA and IJA skills. It seems that social orienting variables in this study could however not account for this shared variance.

The amount of eye contact and alternates used by children to initiate joint attention was only related to the time spent looking at the eyes in the video clip. Preferring to look at the eyes rather than at a dynamic, attractive mouth region may reflect a very strong rewarding value of the eyes as social cues. This preference may therefore be related to a strong underlying social motivation, which also leads children to participate in triadic interactions. The finding that social orienting was related to IJA on a lower level and not on a high level could be due to the somewhat later emergence of pointing and showing behaviours in development, therefore not occurring at rates sufficient to carry meaningful variance at the age of 12 months (Mundy et al., 2007). It must be noted that the measure for low IJA skills consists of making eye contact and alternates. Therefore, one could argue that this could also be a measure for the preference for the eyes of the experimenter, rather than for the amount of social sharing. The question then raises at which point the preferential looking to the eyes of another person, perhaps mostly based on visual characteristics, changes to a means of sharing attention. Social cognitivists will probably argue that infants need to understand mental states in order to take this turning point and to participate in triadic interactions (Tomasello, 1995). Recently, Mundy et al. (2009) proposed a model in which joint attention is viewed as an information-processing system, based on the integration of self-attention and attention of other people. The tendency to orient to social cues is considered crucial in this development, since children need to observe other people in order to link their own visual attention to the visual attention of others. It is assumed that through this integration, children come to show triadic abilities. A preference to look at the eyes of another person at the age of 6 months, probably still reflects the mere observation of the attention of others, which at a later point can be integrated with self attention, leading to joint attention skills at the age of 12 months. This can also explain how triadic abilities of children are built on earlier dyadic abilities (Striano & Rochat, 1999).

Contrary to our expectations, no significant correlation was found between the social orienting in photographs of real life situations and the initiation of joint attention. The social orienting behaviour of children, neither the latency time to orient to a social stimulus, could predict their initiation of joint attention skills. Off course, the relatively small sample size demands cautiousness in interpreting these results. As put forward for

RJA skills, also here we can interpret that perhaps children do need a social preference in their development of joint attention skills, but the amount of social preference they show is less important. When children have the opportunity to orient to social stimuli, a modest amount of social orienting may be sufficient to develop joint attention. Children who orient towards social cues when presented with faces seem to be better in joint attention skills, but this is not necessarily the case for children who actively seek out social cues (realistic photographs). If children need a basic tendency to prefer social stimuli, this could imply that children who experience difficulties with joint attention reach an insufficient amount of social orienting, even when presented with the opportunity. Possible causes could be an impaired motivational system, disturbed early visual processes, or insufficient opportunities to look at social cues early in life. Another alternative interpretation of the lack in meaningful differences in social orienting, is that all typically developing children might have the same tendency to orient to social stimuli, but that their individual differences in the degree to which they show this preference depend on factors that are unrelated to social development. Frank et al. (2009) put forward the possibility that children differ in their orientation to social stimuli because of differences in attentional control and in the ability to suppress the effects of distracting background information. More research is needed to investigate the underlying sources of individual differences in social orienting behaviour of young infants.

General conclusion

Both response to, and initiation of joint attention skills were to some extent related to the earlier preference of children to look at the eyes of another person. This finding is in line with other studies (e.g., Dawson et al., 2004), in which the magnitude of the reported correlations was similar to those reported in this study. Modest and inconsistent patters of correlations were to be expected because obtaining reliable measures is quite challenging in infant research, and because of the rather brief nature of the observation methods. However, as social orienting is regarded as an early contributing factor in the development of joint attention, but joint attention probably also involves development in factors not necessarily reflected in social orienting, our data provided reasonable support for the hypothesized contributions of social orienting to joint attention. No associations were found with social orienting in real life photographs. The finding that there are only limited associations between the social orienting of children and their later joint attention skills, does not necessarily imply that social orienting is not important in early social-communicative development. The innate tendency to orient to social stimuli could in itself provide a solid base on which children can build their social-communicative skills, independently from the degree to which they display this social preference. Future research in children with typical as well as atypical development, using different types of stimuli, is needed to determine to what extent social orienting is involved in the development of social-communicative skills.

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Appendix

Photograph of a realistic everyday situation

Video clip of a female person talking to the child

Tables and Figures

Table 1

Intercorrelations between different social orienting variables

		1	2	3	4	5
1	*% of looking time at social stimuli*	1				
2	*Latency to first social fixation*	-.52**				
3	*% of looking time at eyes neutral face*	-.11	.07			
4	*% of looking time at eyes smiling face*	.42*	-.38*	.02		
5	*% of looking time at face in video*	-.07	.02	-.03	.02	
6	*% of looking time at eyes in video*	.21	-.18	.09	.40*	.23

Note. **$p < 0.01$, *$p < .05$

Table 2

Number of IJA behaviours per minute in both tasks and the composite score

	Basic IJA	Event IJA	Composite IJA
Total	2.41 (1.18)	4.71 (2.79)	3.56 (1.75)
Low	2.18 (1.13)	4.17 (2.41)	3.18 (1.51)
High	.30 (.49)	.54 (1.03)	.42 (.68)

Note. IJA = initiation of joint attention

Table 3

Pearson and Spearman[a] correlations between social orienting tasks and RJA skills and IJA skills

	RJA[a] 8 months	RJA[a] 12 months	IJA	IJA low	IJA high
Photographs of environments					
% of looking time at social stimuli	.10	.11	-.12	-.23	.22
Latency to first social fixation	-.08	.07	.24	.24	.08
Photographs of faces					
Looking eyes neutral face	.38*	.35^	.19	.17	.11
Looking eyes smiling face	.25	-.14	.01	-.14	.28
Video clip of person talking					
% of looking time at face	-.04	.12	.20	.15	.12
% of looking time at eyes	.16	.00	.31^	.36*	-.01

Note.^$p < .10$, *$p < .05$

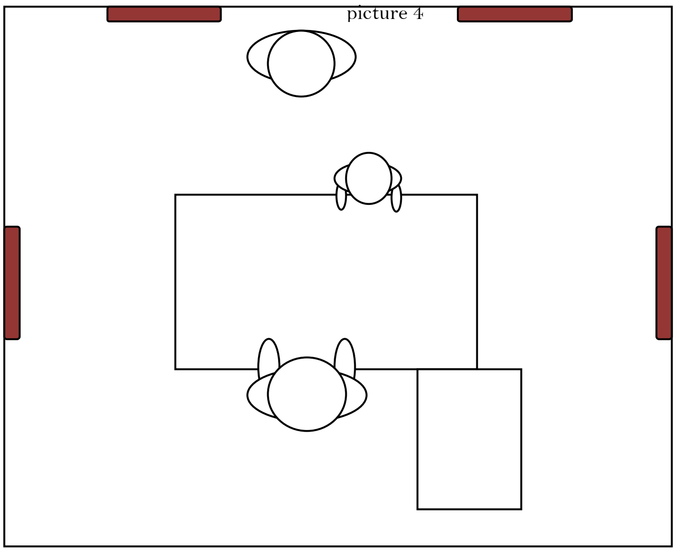
Figure Captions

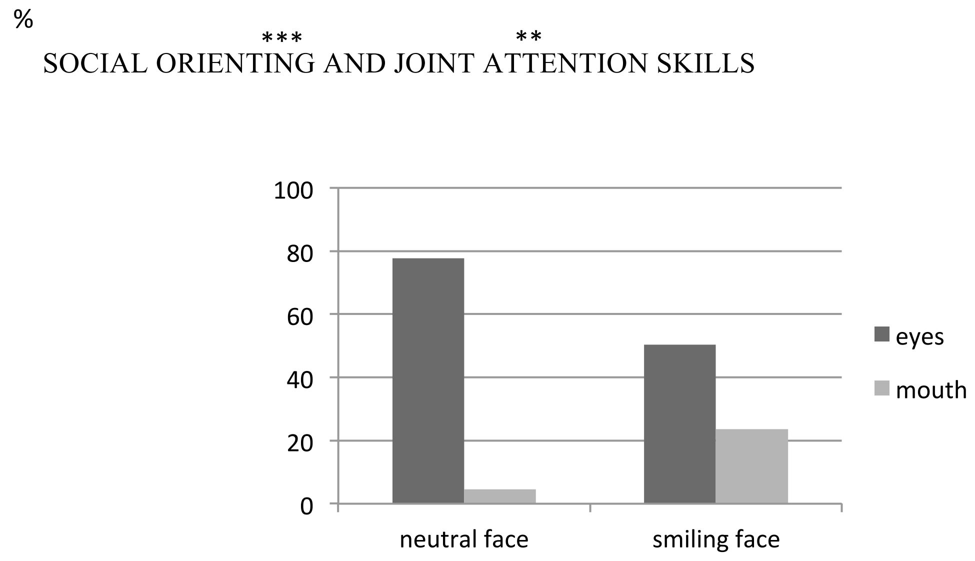
Figure 1. Position of the Four Posters in the Response to Joint Attention Task

Figure 2. Average Percentage of Looking Time at the Eyes and at the Mouth in a Neutral and a Smiling Face

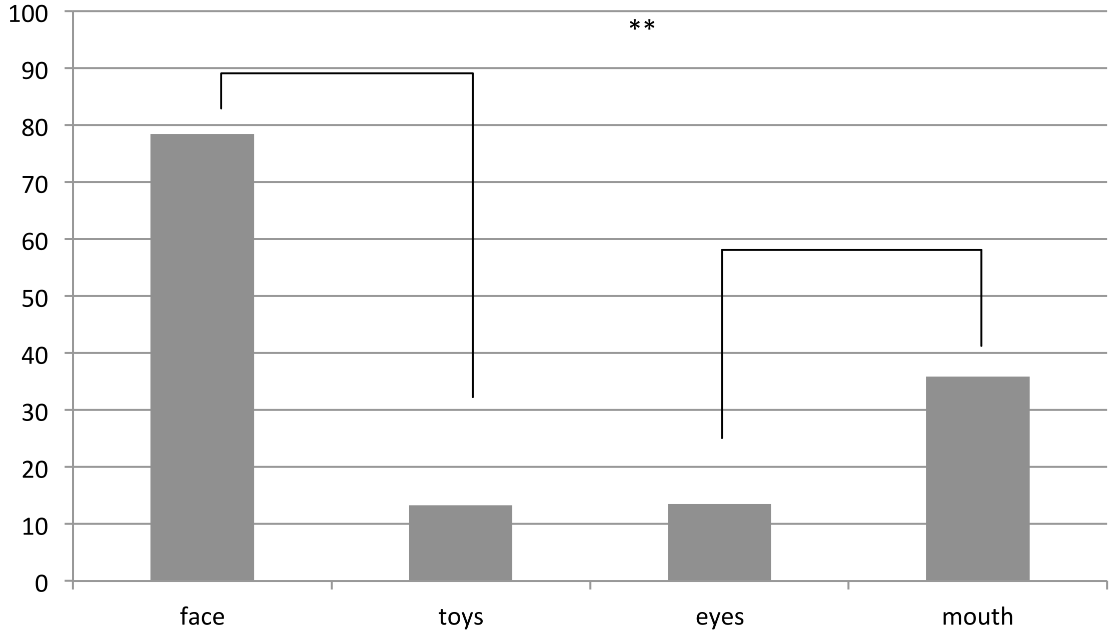
Figure 3. Percentages of Looking Time at Areas of Interest when Observing a Talking Person

picture 3 picture 1 table table with toys picture 2




%
***
**
100
80
60
40
20
0
neutral face
smiling face
eyes
mouth

***


**
100
90
80
70
60
50
40
30
20
10
0
face
toys
eyes
mouth