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Brief report

Seven- to 9-month-old infants use facial expressions to interpret others' actions

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In Study 1, 7-month-old infants ($N = 58$) looked reliably more at an adult's face when she playfully pulled a toy away from them compared with when she simply handed them the toy. In Study 2, 7- and 9-month-old infants ($N = 36$) interacted with an adult who played a teasing game and then held a neutral or happy facial expression. Compared with a baseline in which infants looked equally to both expressions, after the tease, infants looked longer at the neutral compared with the happy expression. By 7 months, infants may use facial expressions to disambiguate others' actions.

An essential part of social cognition is the ability to monitor and understand the motivations and goals of the people around us. One primary and effective way to do this is to look at people's facial expressions (Walker-Andrews, 1997), from which we can glean information about their current dispositions, their underlying intentions and even their future behaviour (Baron-Cohen, 1994). The question of when the ability to use expressions to interpret actions emerges in development has not been addressed.

Some research suggests that infants do not strategically look to others' faces until the last quarter of the first year. For instance, Phillips, Baron-Cohen, and Rutter (1992) compared 9-month-old infants' behaviour towards an experimenter who behaved in either an ambiguous or an unambiguous manner. The ambiguous actions were either a 'blocking' action in which the experimenter gave the infant a toy to hold and then covered the infants' hands with her own, or a 'teasing' action in which she offered the infant a toy and then pulled it away. The unambiguous action was a 'giving' task in which the experimenter handed a toy to the child. All infants made immediate eye contact with the experimenter following both the ambiguous acts, but only 40% did so following the unambiguous task.

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Phillips *et al.* (1992) suggest that by 9 months, infants selectively and actively monitor adults' eyes to disambiguate goals. Similarly, in their examination of the emergence of various joint attention skills between 9 and 15 months, Carpenter, Nagell, and Tomasello (1998) report that the 'age of emergence' of this ability is 10.8 months.

Importantly, however, in both the Phillips *et al.* (1992) as well as the Carpenter *et al.* (1998) studies, infants younger than 9 months were not tested. Indeed, in the Carpenter *et al.* work, nearly one third of the sample (7 out of 24) passed the teasing task at the first visit of the study, suggesting that these infants had probably developed this skill earlier than 9 months. Using a procedure similar to Phillips *et al.* and Carpenter *et al.*, Striano and Rochat (1999) tested 7- and 10-month-old infants in social obstacle tasks (blocking and teasing). Infants showed no differences in the inclination to look to the adult's face during these tasks as a function of age. At 7 months, 8 out of 24 infants, and at 10 months, 10 out of 24 infants looked to the adult's face on at least one teasing and one blocking trial (see also Reddy, 1991).

Given these inconsistencies, we designed the current studies to further assess infants' looking in teasing tasks before 9 months. In Study 1, we assessed 7-month-old infants' looking in ambiguous teasing and unambiguous giving tasks in order to determine if Striano and Rochat's (1999) findings would be substantiated. We predicted that infants would look to an adult's face in the teasing but not the giving task. In Study 2, we extended prior work by examining why infants look to adults' faces. To explore this issue, we manipulated the adult's facial expression during an ambiguous teasing action, and tested whether 7- and 9-month-old infants would behave differently based upon the expression provided. Our working hypothesis was that 9-month-olds, and perhaps 7-month-olds, would look to gather information from the adult's face.

STUDY 1

Method

Participants

Participants in the study were 58 7-month-old infants ($M = 7$ months, 18 days; $SD = 9.68$; range = 6, 22–8, 23; 31 female). One infant was excluded because of fussiness. All participants were living in the east of Germany, and infants received a tee shirt for their participation.

Setting

Infants were seated near the middle of a red mat (2 × 1.4 m), and caregivers sat behind and held infants throughout the experiment. The experimenter (E) sat opposite and 0.5 m away from the infants. Three digital video-cameras filmed infants, E's face and torso and the entire set-up. All images were synchronized with a quad splitter and recorded on a mini-VCR. The toy used to tease infants was a wooden bird with two wheels in place of legs, attached to the end of a wooden stick. When the stick was pushed back and forth on the ground, the bird also rolled back and forth.

Procedure

Mothers were instructed to look down at infants so as not to influence them. To begin the tease task, E rolled the toy towards the infant, rolled it back towards herself and repeated this action. She then held the toy away while looking with a pleasant

expression at the infant, and counted 5 seconds silently. She then repeated this entire procedure once. The give task was the same, except that during the second back-and-forth, E placed the toy on the infant's lap and kept it there for 5 seconds while looking at the infant, allowing the infant to manipulate the toy. The tease and give tasks were counterbalanced across infants, and all infants received both tasks.

Coding

A blind coder coded whether or not infants looked to E's face during tease and give. Reliability was assessed for 20% of the sample by a second independent coder. Agreement between coders was $r = .96$.

Results

Eleven infants looked in either the first or second give trial, whereas 30 looked in either the first or second tease trial. Chi-squared tests indicated that this difference was significant, $X^2(1, N = 58) = 13.62, p < .0005$ (see Figure 1). The pattern of results was the same when considering the first and second trials alone, $p = .010$ and $p = .004$, respectively (see Table 1). To test for order effects, chi-squared tests were conducted, which revealed that infants were equally likely to look to E when they received give first versus tease first. Furthermore, during give trials, infants were equally likely to look to E regardless of whether they received give or tease first. The same was true during tease trials. Thus, our results cannot be attributed to the counterbalancing.

Discussion

These findings are the second demonstration that 7-month-olds look reliably more to an adult when she teases them versus when she gives them an object. Importantly, our sample was significantly larger than that used in prior work (Striano & Rochat, 1999), which strongly suggests that selective looking emerges before 12 months (see Striano & Rochat, 2000).

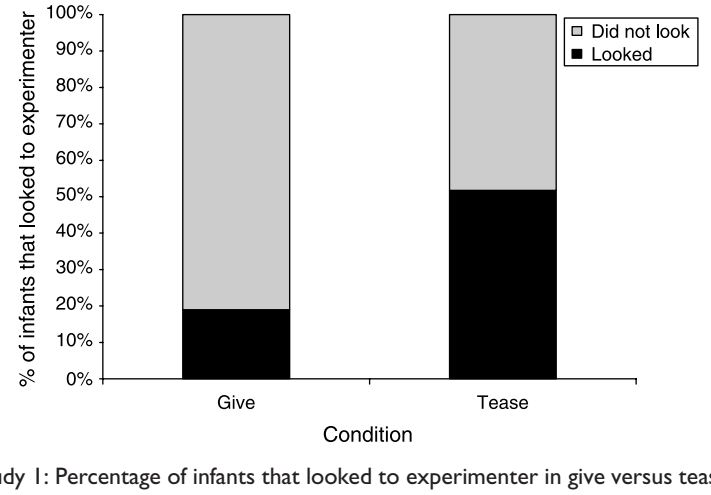

Figure 1. Study 1: Percentage of infants that looked to experimenter in give versus tease (100% = 58 infants).

Table 1. Study 1: Number of infants that looked to experimenter in give versus tease in Trial 1, Trial 2 and across both trials (100% = 58 infants)

	Give (% of total)	Tease (% of total)	X^2	*p* value
Trial 1	6 (10.34%)	17 (29.31%)	6.56	.010
Trial 2	6 (10.34%)	19 (32.76%)	8.35	.004
Total (Trial 1 or 2)	11 (18.97%)	30 (51.72%)	13.6	<.0005

It is possible that infants looked to the adult's face in tease to interpret her behaviour, but infants may have looked during tease because there was nothing else to look at once the toy had been taken away. Moreover, the different locations of the object in the two conditions (near E in tease and near the infant in give) may have affected infants' looking across conditions. To investigate why infants looked to the adult's face, we conducted Study 2 with 7- and 9-month-old infants, in which E teased infants as in Study 1, and then provided them with either happy or neutral facial expressions. In this study, the location of the object was held constant. We hypothesized that if, after being teased, infants look to E's face for information, they should look reliably less when E presents them with a happy expression compared with a neutral expression. This is because the happy expression would provide unambiguous information about E's actions (that she is teasing them), whereas the neutral expression would be ambiguous and therefore likely to elicit longer looking as infants tried to understand E's behaviour.

Importantly, we included a baseline in which E simply held an expression (smiling or neutral) for 20 seconds. Based on prior work showing that infants look longer at happy than at neutral expressions (e.g. Striano, Brennan, & Vanman, 2002), we predicted that in baseline, infants would look longer at E when she held a happy versus a neutral expression. The baseline was included because if, in tease trials, infants looked differently as a function of E's expression, this difference could be attributed to a general tendency of infants to look differently to the two expressions. If, however, infants looked differently at the expressions in baseline versus tease, then any differences in their looking during tease could be attributed to the context of E's behaviour and not merely to the facial expression. In Study 2, we also increased the tease time from 5 to 10 seconds because we were interested in durations of infants' looks, and wanted to avoid a ceiling effect of infants' looking times.

STUDY 2

Method

Participants

Participants in Study 2 were 18 7-month-olds (8 female; $M = 7.16$; $SD = 8.72$; range: 7.01–7.29) and 18 9-month-olds (9 female; $M = 9.1$; $SD = 7.70$; range: 9.00–9.21) participated in this study. An additional 8 were tested but excluded due to fussiness ($N = 7$), and lack of interest in the toys ($N = 1$). All participants were living in the east of Germany, and infants received a small toy for their participation.

Setting

The setting was the same as in Study 1, but we used two toys instead of one to keep infants interested. Two small rattles were used: one cylindrical, and the other shaped

like a mushroom with four beads on top. Both produced similar sounds and were similarly coloured.

Procedure

Seating arrangement and instructions to mothers were the same as in Study 1. E counted all time intervals silently. First, E interacted with infants for 15 seconds as a warm-up, and then asked caregivers to turn infants around such that caregivers and infants were face-to-face, and to interact naturally with the infants. After 15 seconds, caregivers turned infants back to face E, who now held either a neutral or a happy face (counterbalanced) while looking at the infants. E held this expression for 20 seconds after the infant had looked at her. This was the first baseline trial. Next, E introduced the first toy (counterbalanced), manipulated the toy and then handed it to infants. She only went on to the next part of the experiment when infants had handled the toy at least once.

To begin the tease, E took the toy back from infants, playfully moved it near the infants, and when infants reached for it, she moved it 0.5m to the right or left (counterbalanced). She held the toy away for 10 seconds, and in this time, held either a happy or neutral face (counterbalanced). E then brought the toy back to the infants, and repeated the procedure on the other side with the same expression. The next two tease trials were conducted using the same toy but the other expression.

After the first four trials, E again requested caregivers to turn infants to face them and interact naturally with them. After 1 minute, infants were turned around to face E, at which time E held the second baseline expression for 20 seconds, and then began the second tease session with the second toy. This session was the same as the first, except with the order of expressions reversed for counterbalancing. To summarize, there were two 20-second baseline phases (happy and neutral) and eight 10-second tease trials (four happy and four neutral).

Coding

Duration of looks to E's face during baseline and tease were coded. E's facial expression was covered during coding to ensure blind coding. A second coder checked a random 20% of the sample ($N = 8$) to ensure that baselines had been conducted for 20 seconds and tease trials for 10 seconds, and to ensure that during tease trials, E only pulled away the toy once the infant reached for it. Agreement on all measures was 100%.

Reliability

For the reliability coding of whether an infant looked to E in a trial or not, agreement was above 95%. A blind coder coded durations of looks for 20% of the sample. For all trials, Pearson's correlations between coders were significant, $p < .025$.

Results

Initial analyses revealed no significant effects of toy, gender or age group, and no effects of order of emotion in baseline or in tease. There were seven 7-month-olds and seven 9-month-olds that looked to the adult's face on the first happy and first neutral trial. Of these 14, the first baseline-tease pair was happy baseline-happy tease for 4 infants, neutral baseline-neutral tease for 4, happy baseline-neutral tease for 3 and neutral baseline-happy tease for 3. Since the four possible orders were quite evenly distributed

across infants, any effects found in this data would not be the result of any one counterbalancing order.

Infants' first looks in the happy and neutral baselines and in the first happy and neutral tease trials were isolated. A 2 (emotion: happy, neutral) × 2 (condition: baseline, teasing) repeated measures ANOVA was conducted using durations of infants' looks as the dependent variable. Since all 14 infants' first looks during baseline were under 10 seconds, they could be compared with first looks during tease. There was a significant difference across emotions, $F(1, 13) = 7.53$, $p = .017$, indicating that, overall, infants looked longer at neutral ($M = 2.83$) than at happy expressions ($M = 1.92$). This effect is best interpreted in the context of the significant interaction between expression and condition, $F(1, 13) = 4.99$, $p = .044$. To further examine this interaction, paired-samples *t* tests were conducted. As predicted, in tease trials, infants' first looks to E were significantly shorter when E was happy ($M = 1.64$, $SD = 1.21$) versus neutral ($M = 3.14$, $SD = 2.02$, $p = .003$). In baseline trials, there was no difference in duration of infants' first looks to either expression, $p = .475$ (Figure 2).[1]

Discussion

In Study 2, equal numbers of 7- and 9-month-old infants looked to an adult's face during an ambiguous task, further supporting the findings of Striano and Rochat (1999). These infants also manifested different patterns of looking based on context. During baseline (i.e. in the absence of an ambiguous event), infants looked equally at the happy and neutral expressions. Importantly, however, both 7- and 9-month-olds looked less to the adult when she teased them with a smile than with a neutral expression. This suggests that infants were looking to the adult to interpret her ambiguous action, and when they received information that she was teasing them (as indicated by her smile), they looked away. However, when the adult's intention was unclear (in the neutral condition), infants looked for longer, perhaps because they needed more time to interpret her behaviour.

GENERAL DISCUSSION

In two studies, we assessed infants' looking to an adult's face in the context of a teasing task. In the first study, we showed that this skill is robustly present by 7 months, since infants in this age group looked to the adult's face when the adult teased them but not when she simply gave them an object. In prior studies (e.g. Carpenter *et al.*, 1998; Philipps *et al.*, 1992), researchers argued that this skill emerges by 9 months or later, but Study 1 shows that this skill is in place several months earlier.

In Study 2, we explored why infants looked to the adult's face by manipulating the adult's facial expressions and the contexts in which those expressions were presented. During the tease task, when the adult's expression provided unambiguous cues about what the actor intended (i.e. the adult is smiling; therefore, she is teasing them), infants looked for a shorter duration to the adult's face than when she presented ambiguous cues that were not interpretable in the situation. These findings suggest that in this

[1] *Two additional analyses were conducted. First, we analyzed these 14 infants' total duration of looks in the first tease trial, and found similar results as with analyses of infants' first looks. We also analyzed first looks from the first tease trials in which infants looked, but found no significant differences across conditions.*

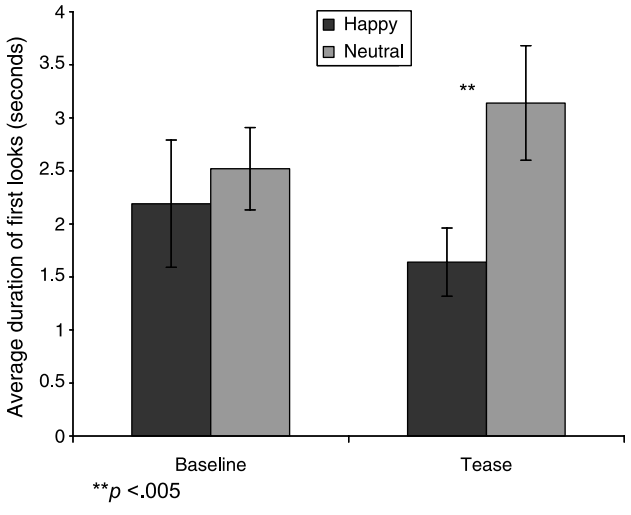

Figure 2. Study 2: Average duration of first looks to experimenter in happy and neutral baseline versus in first happy and neutral tease trials ($N = 14$).

ambiguous (teasing) task, infants were looking for information about the actor's intentions.

Importantly, when they saw the same expressions during a simple baseline, they looked equally to both expressions, suggesting that they were not looking for information in baseline. Thus, results from Study 2 suggest that infants in prior studies (see Phillips *et al.*, 1992; Striano & Rochat, 1999) were looking to the adult's face to interpret her action, and not simply because there was nothing else to look at (see Baldwin & Moses, 1996).

The current studies show that infants probably use others' expressions to interpret actions before the end of the first year. However, some caution and further research is needed. For instance, perhaps infants look more to a neutral face in the teasing context because they expect people to smile when engaging with objects and this expectation is broken when the experimenter is neutral. Future studies could have the experimenter engage with a toy during baseline as well. Then, if infants look equally in neutral and happy baseline, but look longer in neutral tease, then our interpretation of infants' looks will be supported. However, if infants look longer in neutral baseline, then it is likely that the longer looking to a neutral expression is due to a broken expectation.

One way to extend the current results is to test the same infants in a variety of contexts (not only teasing), some in which the expression is consistent with infants' expectations and other situations in which it is not. It might also be revealing to use multiple social partners to determine how familiarity with the partner interacts with infants' ability to use expressions. We used a stranger as the experimenter, but we would expect even more robust results if infants' mothers had acted as the experimenter. It is also important to establish how experience with teasing games and emotional expressions in general might impact infants' emerging ability to use emotional cues to disambiguate others' actions.

In sum, using others' facial expressions is one means by which to disambiguate their actions and behaviour. Here, we show that this skill begins to unfold in development as early as 7 months of age. The key for future research is to establish the underlying mechanisms that contribute to these developments.

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