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Twelve-Month-Old Infants' Sensitivity to Others' Emotions Following Positive and Negative Events

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This study investigated infants' sensitivity to others' congruent and incongruent emotional reactions to positive and negative events. Thirty-six 12-month-old infants viewed three distinct interpersonal events (give a toy, break a toy, fight over a toy) followed by an emotional expression (happiness, sadness, anger) that was either congruent or incongruent with the preceding event outcome. The duration of infants' looking toward each emotional reaction was examined. Infants demonstrated sensitivity to incongruent emotional reactions for the give and fight events, representing the earliest evidence to date of emotional sensitivity to negative events.

Understanding others' emotions is essential for social competency and involves anticipating, appreciating, and responding appropriately to others' affective communication (Saarni, 1999). A substantial body of research exists examining infants' discrimination of affect (see Walker-Andrews, 1997), social referencing (see Walle, Reschke, & Knothe, in press), and responding to others' emotions (see Walle & Campos, 2012). However, research examining infants' sensitivity to others' emotional reactions to specific events remains limited and was the focus of the present investigation.

Infants' sensitivity to the congruency of emotions and event outcomes develops between 8 and 18 months of age. Previous research found that 10-month-olds, but not 8-month-olds, looked longer at an agent's sad expression than a happy expression following a positive event outcome (e.g., arriving at a desired location), but both age groups looked equally at these expressions following a negative outcome (Skerry & Spelke, 2014). Other work using pupil dilation to index sympathetic arousal found that 10- and 14-month-olds detected incongruent emotions when observing an angry actor perform a positive action (i.e., patting a toy tiger while scowling), but only

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14-month-olds detected emotional incongruency when observing a happy actor perform a negative action (i.e., thumping a toy while smiling; Hepach & Westermann, 2013). Additional research with older infants found that 18-month-olds, but not 15-month-olds, increased their visual checking behaviors when observing positive reactions to negative events and negative reactions to positive events, and did not deem neutral reactions to negative events as incongruent (Chiarella & Poulin-Dubois, 2013, 2015). Thus, infants appear to be sensitive to events eliciting positive emotions at 10 months, but are not sensitive to events eliciting negative emotions until 14–18 months of age.

This age discrepancy may be due to a number of methodological differences. First, studies have been inconsistent in their use of negative emotions, giving a fragmented picture of emotional development. For example, some studies use anger, a negative emotion high in arousal, whereas other studies use sadness, an emotion low in arousal (see Russell & Bullock, 1985). Second, studies of 8- to 14-month-olds have used *intrapersonal* events (Hepach & Westermann, 2013; Skerry & Spelke, 2014), whereas studies of older infants have used *interpersonal* events (Chiarella & Poulin-Dubois, 2013, 2015). The social nature of emotion may suggest that infants more readily appreciate affect in *inter*personal contexts (Walle & Campos, 2012). Finally, previous studies have differed in their selection of dependent variables (i.e., looking behavior, pupil dilation, visual checking), making it difficult to compare results across studies.

To address some of the above issues, this study included one positive emotion response (i.e., joy) and two negative emotion responses (i.e., sadness and anger), allowing comparison between three discrete emotions varying in valence and arousal. Additionally, interpersonal emotion contexts were used (giving a toy, breaking a toy, and fighting over a toy). We tested 12-month-old infants using a violation-of-expectation procedure, a paradigm in which 10-month-olds have demonstrated sensitivity to others' incongruent emotional reactions to positive, but not negative, events (Skerry & Spelke, 2014). Additionally, prior research demonstrates that infants at this age can discriminate each of the included facial expressions (see Flom & Bahrick, 2007).

METHOD

Participants

Thirty-six 12-month-old infants (M = 11.8 months, SD = 0.48; 17 females) completed the study. Twenty-six participants were Caucasian, eight were Hispanic, one was Asian, and one was African American. Participants came from socioeconomically diverse backgrounds, with average family income being $50,000 (range: <$25,000 to >$150,000 per year) and primary caregiver education ranging from no high school to a graduate degree. Thirty additional participants were tested but excluded because of fussiness (n = 7), sibling distraction (n = 6), inattentiveness to the events (n = 5), procedural error (n = 4), parental interference (n = 4), external noise (n = 3), and equipment failure (n = 1).

Apparatus

Infants sat in a highchair or on their caregiver's lap at a table approximately 0.5 m across from a television monitor. Caregivers were instructed to not distract the infant. Other individuals accompanying the family were directed to sit quietly in a separate room. A webcam transmitted a live feed of the infant and caregiver to a separate computer.

Stimuli

Test stimuli consisted of three 8-sec videos of a protagonist (P) and a social partner (S) sitting and engaging in one of three interpersonal events (give, break, fight; see Figure 1a). These events were selected based on their differences in core relational theme (see Lazarus, 1991) and strong association with a single emotion: give = obtaining a goal (happy), break = irrevocable loss (sad), fight = goal blockage that may be overcome (anger; see Barden, Zelko, Duncan, & Masters, 1980). S wore a yellow visor concealing her upper face and making her distinct from P. Both actresses expressed neutral affect during the following events:

Give event: S looked at and held, but did not play with, a triangle toy. S turned to P and handed her the toy. P took the toy, turned it upside down, and watched a moveable wheel spin.
Break event: P looked at a plush bunny and made it "dance." S looked toward P, took the bunny from P, tore off the bunny's leg, and set it down on the table.
Fight event: P looked at a stuffed caterpillar and made it "gallop." S looked at the toy and tried to take it from P, who pulled it back. P and S tugged the toy back and forth three times.

Each event was immediately followed by a static, close-up image of P displaying an affective expression (happy, sad, angry; see Figure 1b). Twenty-three undergraduate students (13 females, mean age = 20.00 years) independently viewed and categorized each facial expression as expressing joy, sadness, fear, anger, disgust, or surprise. All expressions were recognized as conveying the intended emotion (range: 91–100%).

Figure 1 Screenshots of the event (a) and emotion (b) stimuli. For each test trial, infants observed an event followed by an affective expression.

Design

Nine possible event–emotion pairings were derived from the events and emotional reactions. Pairings were separated into three unique conditions, each comprised of one congruent pairing and two incongruent pairings. This ensured that infants viewed each event and emotion only once, thus minimizing familiarization effects across trials. Infants were randomly assigned to the following conditions (congruent pairing italicized): Condition 1 = *give-happy*, break-angry, and fight-sad (n = 12); Condition 2 = give-angry, *break-sad*, fight-happy (n = 12); Condition 3 = give-sad, break-happy, *fight-angry* (n = 12). The ordering of pairings within each condition was randomized. We predicted that infants would look longer to incongruent pairings than congruent pairings. Our predictions of infants' sensitivity to incongruent negative reactions to negative events (e.g., sadness following the fight event) were based on theoretical (Lazarus, 1991) and empirical work (Barden et al., 1980) suggesting that not all negative emotions are equally appropriate responses to negative events.

Procedure

A researcher naïve to conditions regulated the flow of stimuli by viewing the live video feed and pressing a keyboard button when the infant attended to the screen. The stimuli flow consisted of the following trials:

Baseline: A novel, 14-sec audiovisual presentation was displayed to elicit infants' attention toward the screen. Infants were shown each static affective expression of P twice in a randomized order to provide a baseline index of infants' general attention to the visual stimuli. Baseline trials were displayed until the infant looked away consecutively for 2 sec, and each trial was separated by a 4-sec countdown audiovisual clip that directed infants' attention to the screen.

Test: Following the baseline trials, infants watched another novel 14-sec reorienting presentation. Infants then observed an event (give, break, fight) immediately followed by a still image of P conveying a facial expression (happy, sad, angry). This image was displayed until the infant looked away consecutively for 2 sec, at which point another 14-sec reorienting presentation was shown. This process repeated until infants saw the remaining event–emotion pairings in their assigned condition.

No infants looked for the maximum trial length of 45 sec in baseline or test trials.

Coding

An experimenter naïve to the hypotheses and conditions of the study viewed the recordings offline and coded frame-by-frame the total amount of time infants looked toward the monitor during each static face presentation (baseline and after each test event). A second experimenter, blind to conditions, coded 20% of trials offline (interrater agreement: r = .93).

RESULTS

Data were log-transformed prior to the analyses to reduce positive skew (see Csibra, Hernik, Mascaro, Tatone, & Lengyel, 2016). Preliminary analyses revealed that infant looking time did not differ significantly as a function of trial, infant gender, or lap placement (highchair versus lap), *p*s > .16. Thus, subsequent analyses were collapsed across these variables.

Infant looking time was analyzed using a repeated measures analysis of covariance (ANCOVA) with event (give, break, and fight) and emotion (happy, sad, angry) as within-subjects factors. Infants' average looking to the baseline trials was included as a covariate to control for individual differences in attention to visual stimuli. Excluding the covariate did not change the pattern of results.

The ANCOVA revealed no main effects of event, $F(2, 98) = 1.17$, $p = .32$, $\eta_p^2 = .023$, or emotion, $F(2, 98) = .88$, $p = .42$, $\eta_p^2 = .018$. Central to our hypotheses, a significant event × emotion interaction was present, $F(4, 98) = 6.22$, $p < .001$, $\eta_p^2 = .202$ (see Figure 2). Specifically, within the give event, infants looked significantly longer to the angry face ($M = 6.50$, $SE = 1.15$) than the happy face ($M = 2.81$, $SE = 1.16$), $t(22) = 4.15$, $p < .001$, $d = 1.77$, 95% CI = [0.42, 1.26], significantly less to the sad face ($M = 4.23$, $SE = 1.16$) than the angry face, $t(22) = 2.12$, $p = .046$, $d = 0.90$, 95% CI = [0.01, 0.85], and longer to the sad face than the happy face, although this difference did not reach statistical significance, $t(22) = 1.98$, $p = .06$, $d = 0.84$, 95% CI = [−0.02, 0.83], and thus did not fully support our prediction. Following the fight event, infants looked significantly longer to the happy face ($M = 7.01$, $SE = 1.15$) than the angry face ($M = 4.28$, $SE = 1.15$), $t(22) = 2.52$, $p = .02$, $d = 1.07$, 95% CI = [0.09, 0.90], supporting our hypotheses, and also longer to the happy face than the sad face ($M = 4.33$, $SE = 1.15$), $t(22) = 2.43$, $p = .02$, $d = 1.04$, 95% CI = [0.07, 0.89]. However, contrary to our predictions, infant looking to angry and

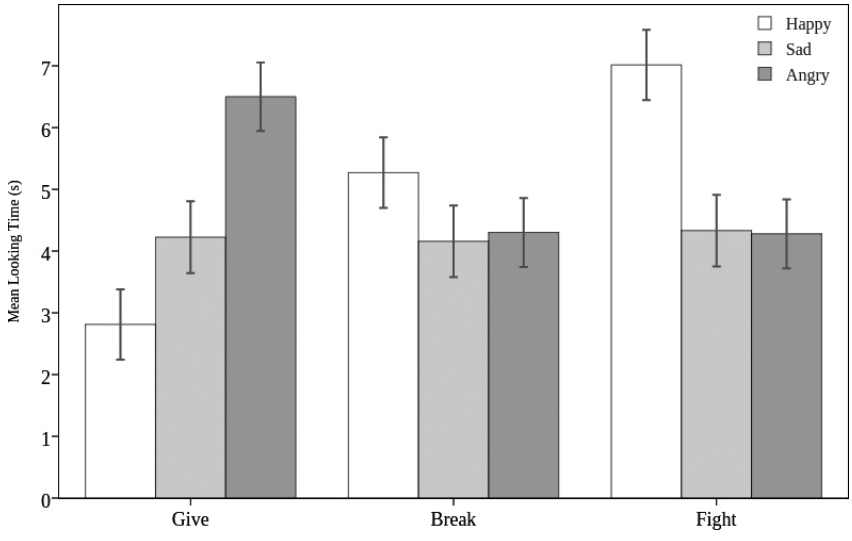

Figure 2 Estimated marginal means of infant looking time to happy, sad, and angry emotions as a function of event. Error bars represent 95% CI.

sad faces after the fight event did not differ, $p = .95$, and no significant differences were observed in infants looking to emotion faces following the break event, $ps > .26$.

To verify that a small number of infants with extreme looking time scores in each condition were not responsible for the findings, nonparametric tests examined how many infants exhibited the above patterns in the give and fight events. Individual looking times in each comparison group were compared to the group mean of the other group to tally how many infants exhibited the observed patterns. Results indicated that a majority of infants demonstrated the patterns at the individual level (range: 18/24 to 23/24, all $ps < .05$, two-tailed binomial tests), confirming the pattern of findings from the ANCOVA.

DISCUSSION

Infants demonstrated sensitivity to another individual's incongruent emotional responses to two of three interpersonal events. In support of our predictions, infants looked longer at a protagonist's angry facial expressions after being given a toy than when she conveyed a happy facial expression. A similar difference was present when sadness followed the give event, but this effect fell short of reaching statistical significance. Additionally, infants looked longer at an angry expression than a sad expression following the give event. This may be because anger was both unexpected for this event *and* high in arousal, resulting in increased infant attention (Russell & Bullock, 1985).

In partial support of our predictions, infants looked longer at a happy facial expression than an angry or sad facial expression after observing individuals fighting over a toy. However, contrary to our hypotheses, infants did not differentiate between the anger and sadness emotions following the fight event. It is possible that infants first perceived the fight event as ongoing goal blockage, but interpreted the pause at the end as an indication of "giving up" (see Barden et al., 1980). Thus, infants may have expected sadness and anger as immediate responses to this event. Finally, inconsistent with our predictions, infants did not exhibit differential looking toward affective facial expressions following the breaking of a toy. It is possible that infants' understanding of the emotional consequents of "breaking" actions emerges later in development (e.g., Chiarella & Poulin-Dubois, 2013), possibly due to infants' infrequent experiences of irrevocable loss at this age compared to other experiences, such as goal blockage (Biringen, Emde, Campos, & Appelbaum, 1995).

This is the first study to demonstrate that infants as young as 12 months of age are sensitive to emotionally incongruent responses to positive (i.e., give) and negative (i.e., fight) interpersonal events. This capacity had previously not been found until 18 months of age, possibly due to the nature of the interpersonal events used (e.g., whole person versus arm; Chiarella & Poulin-Dubois, 2013). Moreover, these results extend prior research indicating that 10-month-olds detect emotion incongruency following positive events, but not negative events (Hepach & Westermann, 2013; Skerry & Spelke, 2014).

Our results have important implications for understanding infant emotional development. First, infant sensitivity to event–emotion congruency may be contingent on understanding goal-directed actions (see Reschke, Walle, & Dukes, 2017). Research suggests that understanding successful intentional actions precedes understanding failed actions,

with the latter emerging at 10 months (Brandone & Wellman, 2009). The current findings paired with previous research suggest that infants' emotional expectations of successful and failed actions may follow this sequential unfolding. Indeed, although the 10-month-olds in previous research (Skerry & Spelke, 2014) and the 12-month-olds of the current study likely appreciated failed intentional actions, only the 12-month-olds detected affective incongruency in both positive and negative events.

Second, infants' sensitivity to others' emotions may be associated with their own emotional experiences (see Walle & Campos, 2012). Infants demonstrate increased social autonomy between 11 and 14 months, which corresponds with increased parental prohibitions (Biringen et al., 1995). As such, 12-month-olds may be more experienced with their goals being accomplished or frustrated by social partners than 10-month-olds, and thus are better able to appreciate interpersonal relations in social contexts. Alternatively, the goal relations of our events may have been easier to comprehend than the negative events in previous research, such as when an agent's "intended" action is not directly observed (Skerry & Spelke, 2014) or when the goal is more ambiguous (Hepach & Westermann, 2013). However, the scope of the present study prevents conclusions regarding these possibilities.

Our findings provide the earliest evidence of infants' sensitivity to others' incongruent affective reactions to both negative and positive events. Further research is needed to investigate the developmental unfolding of infants' appreciation of emotion elicitors. We advocate that future studies include additional interpersonal events and discrete emotional outcomes (e.g., disgust, fear), assess concurrent infant cognitive functioning (e.g., goal understanding), and explore infant social behaviors that may facilitate the development of such understanding.

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REFERENCES

Barden, R. C., Zelko, F. A., Duncan, S. W., & Masters, J. C. (1980). Children's consensual knowledge about the experiential determinants of emotion. *Journal of Personality and Social Psychology*, *39*, 968–976.

Biringen, Z., Emde, R. N., Campos, J. J., & Appelbaum, M. I. (1995). Affective reorganization in the infant, the mother, and the dyad: The role of upright locomotion and its timing. *Child Development*, *66*, 499–514.

Brandone, A. C., & Wellman, H. M. (2009). You can't always get what you want: Infants understand failed goal-directed actions. *Psychological Science*, *20*, 85–91.

Chiarella, S. S., & Poulin-Dubois, D. (2013). Cry babies and pollyannas: Infants can detect unjustified emotional reactions. *Infancy*, *18*, E81–E96.

Chiarella, S. S., & Poulin-Dubois, D. (2015). "Aren't you supposed to be sad?" Infants do not treat a stoic person as an unreliable emoter. *Infant Behavior and Development*, *38*, 57–66.

Csibra, G., Hernik, M., Mascaro, O., Tatone, D., & Lengyel, M. (2016). Statistical treatment of looking-time data. *Developmental Psychology*, *52*, 521–536.

Flom, R., & Bahrick, L. E. (2007). The development of infant discrimination of affect in multimodal and unimodal stimulation: The role of intersensory redundancy. *Developmental Psychology*, *43*, 238–252.

Hepach, R., & Westermann, G. (2013). Infants' sensitivity to the congruence of others' emotions and actions. *Journal of Experimental Child Psychology*, *115*, 16–29.

Lazarus, R. S. (1991). *Emotion & adaptation*. New York, NY: Oxford University Press.
Reschke, P. R., Walle, E. A., & Dukes, D. (2017). Interpersonal development in infancy: The interconnectedness of emotion understanding and social cognition. *Child Development Perspectives*, Advance online publication. doi: 10.1111/cdep.12230.
Russell, J. A., & Bullock, M. (1985). Multidimensional scaling of emotional facial expressions: Similarity from preschoolers to adults. *Journal of Personality and Social Psychology*, *48*, 1290–1298.
Saarni, C. (1999). *The development of emotional competence*. New York, NY: Guilford Press.
Skerry, A. E., & Spelke, E. S. (2014). Preverbal infants identify emotional reactions that are incongruent with goal outcomes. *Cognition*, *130*, 204–216.
Walker-Andrews, A. S. (1997). Infants' perception of expressive behaviors: Differentiation of multimodal information. *Psychological Bulletin*, *121*, 437–456.
Walle, E. A., & Campos, J. J. (2012). Interpersonal responding to discrete emotions: A functionalist approach to the development of affect specificity. *Emotion Review*, *4*, 413–422.
Walle, E. A., Reschke, P. J., & Knothe, J. M. (in press). Social referencing: Defining and delineating a basic process of emotion. *Emotion Review*.