

First Impressions During Infancy: The Impact of Counter-information

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Abstract

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Adults rapidly form impressions of others as positive or negative evaluations. They do this given limited information, and they do not easily change those impressions based on counter-information. Infants also form rapid impressions of others based on limited information. We investigated whether infants change their initial judgments about people when given counter information. The study of fairness is an ideal modality for investigating this question in infants, due to prior research indicating that infants form rapid impressions of fair and unfair agents and choose to associate with fair over unfair agents. We presented 13- and 17-month-old infants with initial information that one person was fair and another was unfair, and then conflicting information where the two actors reversed roles. In Experiment 1 we measured their social preferences at both time points. Extending prior work, infants chose the fair agent after the initial set of information. After receiving conflicting information, infants chose the fair and unfair agents at chance, although some evidence suggested that infants' responses on the second test trial may have reflected motor perseveration from the first trial. Thus, in Experiments 2 and 3 we measured infants' preferences only at time point 2 after receiving both sets of information; infants again chose the fair and unfair agents at chance after viewing conflicting information.

These findings provide evidence that infants do not stick with their first impressions of people when exposed to information that conflicts with their initial impression, and therefore may not make dispositional inferences of others based on social information.

First Impressions During Infancy: The Impact of Counter-information

There is a common saying that “you only have one chance to make a first impression.”

Impression formation is the process by which one forms an overall positive or negative feeling of someone’s character based on their behavior. Throughout our daily interactions, people rapidly form impressions of other people based on minimal information. Forming valenced impressions of others as positive or negative may be automatic, and researchers have argued that this would be evolutionarily adaptive in that one uses any available information about others in order to aid in social interaction and survival (Bar, Neta, & Linz, 2006). However, people don’t always act in a consistent manner, and thus first impressions of others are not always accurate. Research shows that adults do not easily change their first impressions of people despite receiving information that conflicts with their first impressions (Crawford et al. 2008; Gawronski, Rydell, Vervliet, & Houwer, 2010), but the evidence for what children do in response to conflicting social information is less clear (Cain, Heyman, & Walker, 1997; Kalish 2002). In order to investigate the developmental underpinnings of impression formation and stability, the present set of studies asks what infants do after receiving two sets of conflicting information about others.

Adult & Child Impression Formation

Adults reliably form first impressions quickly and with little information. Willis and Todorov (2006) have demonstrated the automatic quality of impression formation by showing that adults form impressions of faces within one tenth of a second. First impressions not only form quickly, but they also have consequences for our subsequent interactions. In Snyder and Swann (1978) after participants learned personal attributes of other people and were then asked to choose topics to discuss with them, participants tended to choose questions that would elicit behavior that confirmed the previously described attributes. In this way, expectancies caused by

one's first impression guide subsequent communication that in turn reinforces those expectations (Ambady & Rosenthal, 1993). First impressions are thus formed with little behavioral information, but they can deeply influence how we react to others' subsequent actions.

Early work suggested that children do not as readily form impressions of others based on limited information. For example, in a study by Rholes and Ruble (1984), children watched episodes where actors performed a single action and the children were asked to predict the actors' hypothetical future action in a different circumstance. Children 9 years of age and older predicted an actor's behavior would remain the same across contexts, but children between the ages of 5-7 years old did not (Rholes & Ruble, 1984). Indeed, some research suggests that younger children may need more evidence of a person's behavior than older children before they make dispositional attributions (Aloise, 1993). In a similar study based on the previous work, where children heard about past actions and predicted future behaviors, Kalish (2002) also found that older children were more likely than younger children to predict that others would behave consistently in the future as they did in the past. However, the claim that younger children less readily form impressions has been challenged by more recent work. In a study by Cain, Heyman, and Walker (1997), the authors found that children younger than 9 years old predicted consistent future behavior after watching multiple *varied* examples of a behavior. One possible explanation for this discrepancy is that earlier methods measured children's judgments based on hypothetical predictions after receiving an initial set of behavioral information about people, and did not investigate children's expectation of others' subsequent actions in realistic social interactions. Due to the hypothetical nature of these studies, it is possible that young children do expect consistent behavior when actually interacting with a person but not in hypothetical situations. Furthermore, these studies also did not measure the stability of these inferences after exposure to

the subsequent actions of others that conflicted with the children's first impressions. Additional research is needed to evaluate children's reactions to conflicting social information in realistic social interactions.

Adults don't easily change their first impressions in light of new conflicting information. Research on order effects has shown that participants tend to weight initial information, such as in word lists, more heavily than subsequent information (Asch, 1946; Anderson, 1965; Jones, Worchel, Goethals, & Grumet, 1971). When reading a word list of adjectives describing a person, readers formed a valenced impression based more heavily on the beginning of the list than the end (Ham & Vonk 2003). Not only do adults maintain first impressions despite receiving general conflicting descriptive information, but they continue to maintain their first impressions even when those impressions are directly shown to conflict with an individual's subsequent direct actions. In one study, after reading that a person completed one negative action, participants did not change their first impression after learning that the person completed an additional positive action (Gawronski, Rydell, Vervliet, & Houwer, 2010). Adults will even maintain their first impressions despite being directly told that the initial information they received is false after the fact (Crawford et al. 2008). One question that has yet to be addressed is at what age this pattern of behavior develops.

Why Do First Impressions Stick?

One explanation for the stickiness of adults' first impressions is that adults make stable dispositional inferences about people based on behavior (Trope & Higgins, 2011). The rapid nature of first impression formation in adulthood could suggest that impression formation is based on a tendency to make dispositional inferences about others. There is some evidence that children also make dispositional inferences about others. Children label others' dispositions after

receiving as little as 4 pieces of information (Aloise, 1993). Children as young as 3 years old are also able to evaluate faces and reliably attribute “nice/mean” dispositions to those faces (Cogsdill, Todorov, Spelke, Banaji, 2014), and will even choose to label others with dispositional information over categorizing others by simple physical similarities (Heyman & Gelman 2000). This research shows that the tendency to evaluate others with categorical behavioral words may come online fairly early in language development. Because children start labeling others based on behavioral patterns early in life, some have argued that this ability may coincide with the ability to reason about mental states (Yuill, 1992). Being able to reason about mental states and having a dispositional understanding of behavior assists in forming first impressions of others, because forming impressions is based on the assumption that others behave in a consistent manner over time. Some previous work suggests that even children younger than 3 years of age also label others based on their behavior, and thus may have have some concept of dispositions. Children begin to use adjectives when describing others that could be construed as dispositional, such as “nice” and “mean”, around two years of age (Bretherton, & Beeghly, 1982). However, it is unclear whether children at this age use dispositional terms to describe long-lasting patterns of behavior or are simply referring to people in terms of individual preceding actions.

Infant Impression Formation

There has been evidence over the past decade that infants evaluate others based on social information. Hamlin et al. (2007; 2010) showed in a series of studies that when infants see one actor helping an agent up a hill and another actor that hinders that agent climbing the hill, babies show a preference for the helper over the hinderer where infants will look longer at the helper than the hinderer (Hamlin, Wynn, & Bloom, 2007; Hamlin, Wynn, & Bloom, 2010) and

physically reach towards the helper (Hamlin et al., 2010; Hamlin et al., 2007). A study by Choi and Luo (2015) shows that infants also expect Agent A to act friendly toward Agent B only if Agent A did not see Agent B hit another agent, but not when Agent A saw Agent B hit another agent. This tells us that infants are taking in social information about other peoples' behavior and forming impressions based on that behavior. In turn, these impressions influence who they subsequently choose to interact with.

Infants form first impressions based on others' behavior, but it is unclear whether they make dispositional inferences. Some researchers have suggested that infants can do this. In Song, Baillargeon, and Fisher (2005) 13.5-month-old infants were first familiarized with an actor sliding various objects back and forth across a floor. Then infants saw a pre-trial static picture where the actor was seated in front of two identical toys, one which was inside a large frame and the other was inside a small frame. These frames differed in size such that one truck would be able to slide inside the larger frame, while the other truck inside the small frame would be constricted such that it could not slide. Then, infants viewed a test trial where the actor either grasped the truck inside the short or the long frame, that is, either the truck that could slide or the truck that could not. The study found that infants looked longer when the actor grasped the truck that could not slide, than when the actor grasped the truck that could slide. The authors suggested that infants at this age may attribute a disposition to the actor, that she liked to perform the recurring action of sliding objects, and thus infants were surprised when she grasped the truck that could not slide due to the confining frame. However, another interpretation of these findings is that infants merely expected the actor to continue to produce a behavior that she had previously produced.

Other research suggests that infants may be sensitive to others' emotional dispositions. In Repacholi, Meltzoff, Toub and Ruba (2016), 15-month-old infants have been shown to expect an actor to express the same emotion across different contexts. Infants watched an Actor A express anger towards Actor B for playing with toys over several trials, then watched Actor A exhibit a neutral reaction when Actor B played with a last toy. During the test trials, infants were given the last toy and their physical and emotional reactions were measured. Infants' behavior suggested that they expected Actor A to respond angrily when they played with the toy, therefore acting based on their first impression that Actor A was going to be angry (Repacholi, Meltzoff, Toub & Ruba, 2016). Although these findings seem to point to infants' dispositional understanding of others' behavior, it is possible that infants did not receive an equivalent subsequent set of contradictory information because a neutral show of emotion may not be as salient as an angry show of emotion.

Critically, there is little research on what infants do when presented with conflicting behavioral information about someone. The rapid nature of first impression formation in adulthood suggests that impression formation is based on a tendency to make a dispositional inference, and thus we can use information on first impression formation in infancy to understand whether infants also see behavior in terms of dispositions. If infants follow the same pattern as adults, this could point to first impressions as indicators that a behavior is seen as dispositional. However, although we know that infants are able to form impression of others, it is unclear what they do when they are presented with conflicting information. Furthermore, investigating whether infants act according to their first impressions when given conflicting information about the same context may shed light on the developmental underpinnings of first impression formation.

We can use infants' reaction to counter-information to learn whether the way in which infants make and change impressions is similar to older children and adults. For example, imagine a situation where infants get initial information about someone, then they get conflicting information. If infants stick with the initial information, that might indicate that the way in which infants form and change impressions is similar to that of adults. In contrast, if infants go with the secondary conflicting information, that could suggest that the way in which infants form and change impressions is different from that of adults. However, it is also possible that if infants exhibit a pattern of going with the conflicting information that could instead represent a memory limitation, where infants may simply forget the initial information. One way to get at this question is to investigate whether infants' memory abilities, at either the group level or the individual level, are associated with what infants do with conflicting information. If memory is associated with infants' reactions to counter-information at an individual level, then infants with better memory will be less likely to be swayed by counter-information; if memory is associated with infants' reactions to counter-information at a group level, then younger infants would be more likely to be swayed by counter-information and would have poorer memory abilities than older infants. There is a great deal of literature showing that memory ability improves over the course of infancy (Newcombe, Huttenlocher, Drummey & Wiley, 1998; Rovee-Collier, 1999; Seress, 2001; Sluzensky, Newcombe & Satlow, 2004). Investigating the relationship between infants' memory abilities and how they react to counter-information can clarify whether differences between infants' and adults' reactions to counter-information are driven by limitations in infants' memory, or whether they're driven by qualitatively different processes of impression formation and impression change.

Impression Formation Based on Fairness

There are many domains in which one could examine infants' ability to change their first impressions about others in light of conflicting social information. One way to test this question would be to base infants' impressions of others on their concern for fairness. There is recent literature showing that infants not only care about fairness more generally, but they form impressions of others based on their fair or unfair behavior (Burns & Sommerville, 2014; DesChamps, Eason & Sommerville, 2015; Geraci & Surian, 2011; Schmidt & Sommerville, 2011; Sloane, Biallurgeon & Premack 2012). However, there is yet no research on whether infants stick with their first impressions after receiving conflicting information about an individual's fairness. Thus, fairness is a suitable framework in which to investigate how infants treat behavioral counter-information. Egalitarian motives play a fundamental role in how adults behave in society (Dawes, Fowler, Johnson, McElreath, & Smirnov, 2007; Fehr & Schmitt, 1999), where people have been shown to avoid exploiting others for their own gain (Kahneman, Knetsch, & Thaler, 1986). This disapproval of exploiting others is a prime example of how one adheres to the principle of fairness through an aversion to inequality. There are several different models of fairness, and in the current study we focus on fairness based on equality, where when all else is equal people tend to endorse equal distributions of resources between recipients. When some people allocate money unfairly to the rest of the group, others will even punish those who do not act fairly by allocating "negative tokens" that negate the unfair participants' resources (Johnson, Dawes, Fowler, McElreath, & Smirnov, 2009). Adults use fairness information to form impressions of others, where they would tend to prefer those who act fairly over those who act unfairly and will even punish those who do not act fairly (Fehr & Schmitt, 1999).

Children have also been shown to care about fairness. Seven-year-olds prefer to share one additional piece of candy with an in-group member after receiving one piece of candy themselves, rather than keeping all the candy for themselves (1:1 distribution). Furthermore, 7-year-old children prefer an equal distribution of candy over either an advantageous unfair distribution (2:1) or a disadvantageous distribution (Fehr, Bernhard, & Rockenbach, 2008). Pairs of toddlers between the ages of 18- and 24-months old will share equally with each other after having completed a task together, and will even sacrifice resources to establish equality (Ulber, Hamann, & Tomasello, 2015). However, children are not always fair in their allocation of resources (Moore, 2009; Buyun et al., 2016). In Moore (2009) when 4- to 6-year-old children took part in a resource allocation game they shared resources equally with a friend and a stranger, but not another familiar non-friend child, when there was no cost to themselves. However, when there was a cost to share their resources, children only shared equally with a friend and not with either a stranger or a familiar non-friend child. Children will share resources with others fairly in some circumstances but not others, but are increasingly likely to act fairly with age (Shaw et al., 2014; Fehr, Bernhard, & Rockenbach, 2008). For example, in Shaw et al. (2014), children were presented with a number of erasers, some for themselves and some for another nonpresent child. When children knew the experimenter was aware of the number of erasers they had then they chose to divide erasers between themselves and the nonpresent child fairly. However, chose to keep more erasures for themselves when it was clear that the experimenter was unaware that they had more erasures than the nonpresent child. Children, like adults, consider fairness to be preferable to unfairness, and there is increasing evidence suggesting that infants also form impressions of fairness.

A variety of recent evidence suggests that an implicit sense of fairness can be traced back to infancy. Infants expect resources to be divided equally between two recipients in a resource distribution task. For example, after seeing an actor distribute milk, or crackers, between two recipients such that the recipients either received equal amounts of milk/crackers (equal outcome), or one recipient received more (unequal outcome) than the other recipient infants look longer at unequal outcomes, suggesting that they are aware of equality norms and detect when such norms are violated (Schmidt & Sommerville, 2011). Subsequent work revealed that infants not only detect fairness norms, but also prefer those that abide by them. After seeing live distributions where one distributor divided toys fairly (2:2) and another distributor divided toys unfairly (3:1), infants subsequently chose to preferentially receive toys and play with the fair over the unfair actor. Moreover, infants appear to attach valence to fair and unfair behavior, respectively, and by at least the second year of life associate fairness with vocal praise and unfairness with vocal admonishment (DesChamps, Eason & Sommerville, 2015).

Current Studies

Infants form valenced impressions of others based on fairness, and use those impressions to choose fair individuals over unfair individuals. Although research has established that infants can form impressions of others based on their fair and unfair behavior, it is not yet known whether infants change their impressions based on counter information. For instance, it is not clear how an infant would respond if a previously fair person subsequently behaves unfairly. The current study was designed to address two main questions concerning how infants treat counter-information regarding an individual's fairness status. We addressed these questions by presenting infants with information demonstrating that one actor behaved fairly (i.e., distributed toys equally) and another actor behaved unfairly (i.e., distributed toys unequally). Then, infants were

presented with information that conflicts with the actors' initial behavior (i.e., the previously fair actor now acted unfairly). Infants were given the choice of which actor to receive a toy from after receiving the initial set of information, and then again after receiving conflicting information.

We predicted that infants would systematically choose the fair actor after the initial information, replicating prior work using a new paradigm, because prior research has shown that infants as young as 13-months-old show this tendency (Deschamps, Eason, & Sommerville, 2015). The critical question of interest was who infants would choose to receive a toy from after receiving conflicting information: the originally fair actor, or the actor that was most recently fair. Similar to adults, infants could stay with their first impressions despite the counter-information, meaning that they would continue to select the actor that behaved fairly in the initial information. This could mean that infants, like adults, weighed the initial set of information more saliently than the conflicting information.

However, another possibility is that infants could also change their impressions of others in light of counter-information, selecting the actor that behaved fairly *most recently*. If infants change their preference after receiving conflicting information, one explanation would be that infants may have trouble retaining initial information about others' actions after receiving counter-information. Alternatively, infants may simply not think of others' behavior as dispositional.

In the present set of studies, we tested 13-month-old infants and 17-month-olds infants because infants as young as 13-months-old show a preference for fair agents over unfair agents, and to evaluate the possibility that there are developmental changes in infants' impression formation and change during infancy. In these studies, infants viewed videos depicting actors

who allocate resources either fairly or unfairly, then viewed videos where the actors played opposite fairness roles (i.e. the first fair actor was now unfair and the first unfair actor was now fair). Infants' actor preference was by who infants chose to receive a toy from. In Experiment 1 infants made a toy choice after receiving both the initial and counter-information. To preview, the results suggested infants' perseverative tendencies, or the tendency to repeat a prior motor response, may interact with who they choose to receive a toy from after receiving counter-information. Thus, in Experiment 2 infants viewed the initial and conflicting sets of information presented consecutively and only chose a toy after viewing the conflicting set of information. Because the findings from Experiment 2, may be explained by the fact that infants received insufficient information to form an initial impression, in Experiment 3 infants also received a single test trial after receiving both the initial and conflicting information, but we also increased the amount of information such that it matched that presented in Experiment 1.

Infants in Experiment 1 also received a memory task. The purpose of this memory task was to disambiguate the process driving infants' responses in the event that infants went with the counter-information. One option is that infants with poorer memory abilities might go with more recent conflicting information because they forgot the initial set of information. Furthermore, if memory abilities play a role in how infants treat counter-information, given developmental changes in memory abilities over the second year of life, we might expect a difference in infants' performance as a function of age in both the memory task and the fairness task.

Experiment 1

Methods

Participants. Fourteen 13-month-old infants (8 females; mean age = 13 months, 1 day; range = 12 months 20 days to 13 months 11 days) and sixteen 17-old infants (10 females; mean

age = 17 months, 22 days; range = 12 months 21 days to 13 months to 9 days) participated. Infants were typically developing and born at full-term. All participants were Caucasian, and parents identified their education level as having a college degree or higher ($n = 25$) or having some college ($n = 7$).

Participants were recruited from a database of parents who had volunteered to participate in experimental studies. Data from eighteen additional infants were excluded due to lack of response ($n = 11$), fussiness ($n = 5$), reaching attention criteria of an average of 80% on all distribution events ($n = 2$) or technical errors ($n = 1$). The experiment took place in a research laboratory at a large university in the Pacific Northwest. After participation each infant received a toy as compensation.

Procedure. Infants took part in a single testing session where they completed the fairness task.

Fairness task. During the fairness task, the infant sat on their parent's lap approximately 76 centimeters in front of a projector screen. The parent was seated in a rolling chair, such that they could turn away from the screen between trials. Opaque containers were used throughout the task, consisting of a cardboard box with attached tube (See Fig 1). The session was recorded on video and each participant's attention was verified by two independent coders from video after the completion of the session. The fairness task consisted of practice trials followed by two distribution events and two test trials, with each test trial immediately following a distribution event (See Fig 2 for visual depiction of task).

Practice trials. The purpose of the practice trials was to familiarize infants with the action of picking up a toy out of the container, and to increase their likelihood of completing the fairness task. In the first group of practice trials, infants were seated on the parent's lap in front

of a container while an experimenter sat on the ground on the opposite side of the container, across from the infant. The experimenter showed a toy to the infant then dropped it into the tube of the container. After the toy fell through the tube into the bottom of the container, the parent placed the infant on the ground in front of the container, and the experimenter encouraged the infant to take the toy from the container. After the infant either retrieved the toy, or after 1 minute had elapsed and the infant did not retrieve the toy, the experimenter moved on to the next trial. Infants were given the opportunity to retrieve the toy on up to four trials; the experimenter advanced to the second group of practice trials after the infant either retrieved the toy on a total of two trials, or after four trials were administered (if the infant did not retrieve the toy on two trials).

For the second group of practice trials, the container was placed underneath the projector screen with a different toy already placed inside (unbeknownst to the infant). The infant watched a video in which a woman showed the toy to the infant and then appeared to drop the toy into the tube of the container (the tube of the container was aligned with the woman's hand such that the toy appeared to fall into the tube). After watching the video, the infant was placed on the ground in front of the container and the experimenter encouraged the infant to retrieve the toy. Infants were given the opportunity to retrieve the toy on up to four trials; the experimenter advanced to the distribution event after the infant either retrieved the toy on a total of two trials, or after four trials were administered (if the infant did not retrieve the toy on two trials).

Distribution event 1. The purpose of the first distribution event was to teach infants that one actor distributes crackers fairly and another distributes crackers unfairly. Parents were asked to close their eyes in order to remain unbiased, while the infant watched distributions on a projector screen that involved four Caucasian female actors: two distributors and two recipients.

In one video, infants watched a “fair” actor distribute crackers equally between two recipients (3:3 distribution). In another video a different “unfair” actor distributed more crackers to one recipient than the other recipient (5:1 distribution). Each video was presented twice, for a total of four videos (See Fig 3 for visual depiction of distribution event).

Following the distribution event, parents were instructed to turn their chair to face the back wall so the experimenter could set up for the test trial.

Test trial 1. Test trial 1 assessed whether infants show a preference for the fair over the unfair individual. After distribution event 1, videos of both the fair and the unfair distributors appeared on either side of the screen simultaneously. In each video the recipients showed identical toys to the participant before appearing to drop the toys into the real containers underneath each video (as in the second group of practice trials the distributors hands aligned with the tube of the container). Unbeknownst to the infant, the experimenter had already placed identical toys in the containers before each test trial. The participant was then placed on the floor in the center between the video images of the two distributors and the experimenter encouraged the infant to choose a toy. Which distributor the infant approached to take a toy from was recorded. Infants received up to three opportunities to retrieve the toy. Once the infant retrieved a toy the experimenter moved on to distribution event 2.

Following the test trial parents were asked to turn their chair to face the back wall so the experimenter could set up for distribution event 2.

Distribution event 2. The purpose of the second distribution event was to present infants with an additional set of information that conflicted with the first set of information presented in distribution event 1. The structure of the distribution videos was identical to the distribution event 1. However, in the second set of distribution videos, the distributors switched roles such

that the original fair distributor now behaved unfairly, and the original unfair distributor now behaved fairly. Otherwise the switch distribution phase was identical to the initial distribution phase.

Test trial 2. Test trial 2 assessed whether infants show a preference for either the first fair actor (i.e. fair in the distribution event 1) or the most recent fair actor (i.e. fair in the distribution event 2), or if they do not show a preference for either actor after receiving the conflicting set of information. The second test trial followed the same structure as test trial 1: infants saw videos of the distributors showing identical toys and appearing to drop the toys into the container and then infants were encouraged to pick a toy.

Counterbalancing. The order of the fair and unfair distribution videos (fair first versus unfair first), the original identity of the fair actor, which distributor was on the infants' right side during test trial 1, and whether the same actor remained on the infants' right side or switched sides on test trial 2, were counter-balanced across participants.

Coding and reliability. After the completion of each session, the primary experimenter coded infants' duration of looking to the distribution videos, while blind to condition, using JHab attention coding software (Casstevens, 2007). Another trained reliability coder, also blind to condition, independently coded distribution videos for a subset of 10 infants. Looking times between the primary coder and reliability coder were highly correlated ($r(118) = .98, p < .001$). Because there was no difference in coding of looking time between the primary coder and reliability coder, all analyses use the primary coder's looking times.

Memory task. The memory task included an encoding, delay, and retrieval phase.

Encoding Phase. Infants sat on their parents' lap in front of a puzzle propped up on a table. During the encoding phase the experimenter showed the infant that there was a sticker

underneath only one piece of the puzzle by removing and replacing each piece one-by-one. Before removing each puzzle piece the experimenter asked, rhetorically, “Where is the sticker?” When the piece was removed to reveal a blank spot underneath it the experimenter looked at the puzzle piece and shrugged with a negative affect, saying, “No, it’s not there.” In contrast, when the experimenter found the sticker, the experimenter pointed to the sticker and exclaimed with a positive affect, “Look I found the sticker! Awesome! I found the sticker!”

Delay. Once each piece had been removed and replaced, infants walked around the hallway outside the experiment room along with the parent and the experimenter for five minutes.

Retrieval Phase. After the five-minute delay infants returned to the experimental room and sat on their parents’ lap as they did during encoding. The experimenter showed the infant a blank piece of paper with an identical sticker (to the one placed beneath the oval puzzle piece), pointed to the sticker and said, “Where is the sticker? Can you find the sticker? Where is it? Find the sticker!” The parents then rolled their chair up to the table, and infants were allowed to spontaneously interact with the experimenter.

Results

Attention to distribution videos. We examined infants’ attention to the distribution events in order to confirm that infants were able to encode the relevant initial and conflicting information concerning actors’ fairness.

Looking times from the primary coder were converted to proportion scores calculated as infants’ duration attention during the distribution over the length of the distribution video. Attention to distribution event 1 was calculated by averaging across all four videos in the first distribution event; attention to distribution event 2 was calculated by averaging across all four

videos in the second distribution event. The overall attention was calculated as the average of attention scores to distribution event 1 and distribution event 2.

Overall, infants' attention to the distribution events was high ($M = 98.1\%$, $SE = .05\%$), both for 13-month-old infants ($M = 96.9\%$, $SE = .09\%$) and 17-month-old infants ($M = 99.2\%$, $SE = .02\%$). This suggests that infants attended to and encoded the relevant fairness information. Overall, there was no difference between infants' attention to distribution event 1 ($M = 98.4\%$, $SE = .07\%$), and distribution event 2 ($M = 97.9\%$, $SE = .06\%$), ($t(29) = .735$, $p = .468$, $d = .27$). Attention varied according to age group ($t(28) = -2.53$, $p = .017$, $d = .96$), where 17-month-old infants attended to distribution event 1 significantly more than distribution event 2 ($t(15) = 3.11$, $p = .007$, $d = 1.61$), while 13-month-old infants did not differ in their attention between distribution events ($t(13) = .05$, $p = .96$, $d = .03$). However, because attention was high for both distribution events and age groups didn't differ in their choice of the fair actor at either test trial ($\chi(1) = 0.83$, $p = 1.0$), this difference in attention did not drive 17-month-old infants' responses at test. Importantly, these findings indicate that infants were able to encode relevant information within the distribution events, and their attention did not drive responses on either test trial.

Infants' test trial choices. The central analyses of interest were infants' fair actor choices on the test trials. First, in test trial 1 we were interested in replicating prior work showing that when infants receive one set of information about a fair and unfair actor they have a preference for the fair actor. Critically, we were then interested in whether infants change this preference by subsequently choosing the most recent (i.e. the opposite actor from the first fair actor) actor at test trial 2 after receiving the conflicting set of information. The preference for the fair actor was scored as the proportion of trials on which the fair actor was chosen, where the "fair" actor was coded as the actor who distributed fairly *most recently*.

Infants' fair actor choices on test trial 1. There were no significant differences found between 13- and 17-month-olds in their fair actor choice at test trial 1 ($\chi(1) = 0.33$ $p = 1.0$), so the following analysis collapses across age.

To investigate whether infants selected the fair actor above chance on the first test trial an exact binomial test was performed. This analysis indicated that infants chose the toy from the fair distributor over the unfair distributor at test trial 1 significantly above chance, with 24 out of 30 infants choosing the toy from the fair distributor, $p = .001$. Replicating prior work (Burns & Sommerville, 2014; Geraci & Surian, 2011), these findings suggest that infants have a preference for fair agents, and extends these findings down to 13-month-old infants in active choice tasks.

Infants' fair actor choices on test trial 2. To determine whether infants changed their first impressions after receiving conflicting information about the actors, we examined infants' preference for the most recently fair actor at test trial 2. Again, an exact binomial test revealed that there were no significant differences found between 13- and 17-month-olds in their fair actor choice ($\chi(1) = 0.83$, $p = 1.0$), so the following analysis collapses across age. One subject did not respond on test trial 2, so was excluded from analysis. An exact binomial test indicated that infants did not differ in their toy choice from either the fair or unfair distributor, with 16 out of 29 infants choosing the toy from the fair distributor, $p = .711$. When we focused only on infants who chose the fair distributor at test trial 1, we found that 13 out of 23 infants also chose the toy from the fair distributor at test trial 2, $p = .678$. These findings suggest that, as a group, infants showed no systematic preferences on the second test trial, either for the actor that was initially fair, or for the actor that was most recently fair.

Effects of Counterbalanced Variables. Analysis of counterbalanced variables revealed that there was a significant difference in infants' responses on test trial 2 between those who

were presented with the fair actor on the same side at both test trials and those who were presented with the fair actor on a different side from test trial 1 ($t(27) = -2.21, p = .036, d = .85$). Specifically, when picking the fair actor on the second trial entailed producing the same motor response (going to the same side) as the first trial, infants were significantly above chance in picking the fair actor on the second trial ($M = .75, SE = .16, t(13) = 2.51, p = .03, d = 1.39$); when picking the fair actor on the switch trial entailed a different motor response (when the fair choice was on a different side than trial 1), infants were at chance ($M = .38, SE = .18, t(14) = -.76, p = .458, d = .41$).

This suggests there may be two factors that compete for infants' responses on the second test trial – the location at which they previously successfully retrieved a toy, and a tendency to want to affiliate with the most recent fair person.

Memory Task. In order to investigate developmental differences in memory ability, we first analyzed the infants' latency of finding the target sticker after the delay in the memory task. Although 13-month-olds ($M = 15.89$ seconds, $SE = 1.42$) tended to take longer to find the target sticker than 17-month-olds ($M = 11.48$ seconds, $SE = 3.91$), the results revealed that the two age groups did not significantly differ in their latency to find the target sticker ($t(26) = 1.12, p = .273, d = .41$). Subsequently, we were interested in whether memory was associated with infants' fair actor choices in the fairness task. Specifically, we compared latency to find the sticker in the memory task between infants who picked the most recent fair actor at test trial 2 and infants who chose the initial fair actor at test trial 2. When collapsing across age, the results indicate that there is no difference in latency to find the sticker in the memory task between infants who chose the most recent fair actor ($M = 11.24, SE = 1.62$) and infants who chose the initial fair actor ($M = 16.05, SE = 4.1$), in the fairness task ($t(25) = -1.18, p = .250, d = .44$). Together, these results

indicate that there was no association between infants' memory ability and their fair actor choices after receiving counter-information. However, the memory task used in this study may not be sensitive enough to measure individual differences in infants' memory ability. Another possibility is that, rather than treating it like a memory task, infants treated this task like an imitation task. Because the experimenter removed the puzzle pieces in a certain order, infants may have believed the goal of the task was not to find the sticker but to replicate the experimenter's actions. Due to the lack of relationship found between memory and infants' performance on the fairness task, the rest of this paper relies solely on whether their impressions change based on counter-information and the results of the memory task is not included in the results of the following studies.

Experiment 2

Experiment 1 showed that infants overall do not respond systematically after receiving counter-information. However, a closer examination found that infants were more likely to pick the fair actor at test trial 2 when she was presented on the same side as the fair actor in test trial 1. This suggests that infants may have a perseverative tendency to make the same motoric response on test trial 2 they had made previously, which interacts with their tendency to want to affiliate with the most recent fair actor.

Past work has shown that infants are susceptible to perseverative errors, where they have a tendency to make a familiar choice despite changes in context that render their subsequent choice inaccurate (Aguiar & Baillargeon, 2000; Munakata, 1997; Harris, 1974). For example, Aguiar & Baillargeon (2000) found that when 9-month-old infants were simultaneously presented with two cloths, where one cloth was attached to toy on the far side while the other cloth had an unattached toy sitting behind it, infants continued to pull the cloth on the same side

as the previous toy even after the cloths were reversed. In fact, research has shown that infants are much more susceptible to perseveration than adults and even older children (Kirkham & Diamond, 2003; Munakata, Morton, & Yerys, 2003).

In order to ensure infants were not influenced by perseverative tendencies, we conducted a follow-up experiment where infants were presented with initial information and a set of conflicting information within one distribution event. Critically, after receiving both sets of initial and conflicting information infants completed only a single test trial. Because 13-month-old and 17-month-old infants didn't differ in their toy choice from the fair actor at either test trial, in subsequent experiments we tested samples that consisted of only 17-month-old infants.

Methods

Participants. Sixteen 17-month-old infants participated (8 females; mean age = 17 months, 11 days; range = 17 months 9 days to 18 months 9 days). Infants were typically developing and born at full-term. Participants were Caucasian ($n = 10$), Mixed Race ($n = 4$), Asian ($n = 1$), and African American ($n = 1$), and, and parents identified their education level as either having a college degree or higher ($n = 12$), or having some college ($n = 4$).

Participants were recruited from a database of parents who had volunteered to participate in experimental studies. Data from eight additional infants were excluded due to lack of response ($n = 5$), fussiness ($n = 2$), or not reaching attention criteria ($n = 1$). The experiment took place in a research laboratory at a large university in the Pacific Northwest. After participation each infant received a toy as compensation.

Procedure. Infants took part in a single testing session where they completed the fairness task. The session was recorded on video and each participant's attention was verified by two independent coders from video after the completion of the session. The fairness task was

structured after Experiment 1, consisting of practice trials followed by one distribution event, but only one test trial. Within the distribution event, infants were presented with four videos: the first two depicting an actor distributing crackers fairly and another actor distributing crackers unfairly, and the second two videos depicting the same actors switching roles. Critically, in Experiment 2 infants received both initial and conflicting information within one block of videos before test, thus infants received less information overall than in Experiment 1.

Coding and reliability. After the completion of each session, the primary experimenter coded infants' duration of looking to the distribution videos, while blind to condition, using JHab attention coding software (Casstevens, 2007). Another trained reliability coder, also blind to condition, independently coded distribution videos for a subset of 10 infants. Looking times between the primary coder and reliability coder were highly correlated ($r(118) = .97, p < .001$). Because there was no difference in coding of looking time between the primary coder and reliability coder, all analyses use the primary coder's looking times.

Results

Attention to distribution. Overall, infants' attention to the distribution events was high ($M = 98\%$, $SE = .09\%$). There was no significant difference in infants' attention between distribution event 1 and distribution event 2 ($t(15) = 1.7, p = .109, d = .88$). When analyzed separately, there were also no differences found in infants' attention between the fair and unfair distributions for distribution event 1 ($t(15) = .462, p = .651, d = .24$) or for distribution event 2 ($t(15) = 1.55, p = .141, d = .8$). These results indicate that differential attention to the distribution events could not account for fair actor choices on the subsequent test trial.

Infants' fair actor choices on test trial. To determine whether infants preferred the initial fair actor, or the most recent fair actor, we examined infants' toy choice at the test trial

after receiving both sets of conflicting information. Again, infants' toy choice was coded as choosing the fair actor if they chose the toy from the actor who distributed crackers fairly *most recently* in distribution event 2. An exact binomial test indicated that infants chose the toy from the fair distributor at chance, with 7 out of 16 infants choosing the toy from the fair distributor, $p = .8$. These findings indicate that infants showed no systematic preferences on the test trial after receiving both sets of information consecutively, either for the actor that was initially fair or for the actor that was most recently fair.

Counterbalancing Variables. There were no effects of counterbalancing variables on looking time or infants' fair actor choices.

Experiment 3

In Experiment 2, infants did not exhibit any systematic preference for either the first fair actor or the most recent fair actor. One explanation of Experiment 2 is that infants only viewed one video showing the fair distributor, and one video showing the unfair distributor, within each distribution event. That is, infants may have received insufficient information to form an initial impression. Other research assessing infants' impression formation has presented more examples than we used of particular behaviors before measuring infants' responses. In studies by Hamlin and colleagues, infants saw up to seven examples of an agent helping the protagonist, and seven examples of Agent B hindering the protagonist (Hamlin, Wynn, & Bloom, 2007). Similarly, Scola et al (2015) presented at least five videos to infants of a protagonist playing with one agent who gives a ball to play with, and another agent who keeps the ball for himself. In order to overcome this potential limitation of Experiment 2, we matched the amount of information infants received in Experiment 3 to that of Experiment 1.

Methods

Participants. Sixteen 17-month-old infants participated (9 females; mean age = 17 months, 15 days; range = 16 months and 27 days to 18 months and 4 days). Infants were typically developing and born at full-term. Participants were self-identified as Caucasian ($n = 11$), Mixed Race ($n = 3$), Hispanic ($n = 1$), Asian ($n = 1$), and, and parents identified their education level as either having a college degree or higher ($n = 12$), or having some college ($n = 4$).

Participants were recruited from a database of parents who had volunteered to participate in experimental studies. Data from five additional infants were excluded due to lack of response ($n = 4$), or fussiness ($n = 1$). The experiment took place in a research laboratory at a large university in the Pacific Northwest. After participation each infant received a toy as compensation.

Procedure. In Experiment 2 infants were tested on their actor preferences after watching four total videos, two for distribution event 1 and two for distribution event 2, and they responded at chance after distribution event 2. However, in Experiment 1 infants watched a total of eight videos with four videos in each distribution event. Although we know from the results of Experiment 1 that infants form first impressions after watching four videos in distribution event 1, it is possible that infants responded at chance in Experiment 2 because infants simply did not form a first impression after watching only two videos. It is possible that infants need more information than two instances of a behavior can provide in order to form a first impression. In order to match the amount of initial and conflicting information to that of Experiment 1, we tested infants in one of two marginally different versions of a task in which they watched four

videos in each distribution event. The sessions were recorded on video and each participant's attention was verified after the completion of the session.

Both fairness tasks were structured after Experiment 1, consisting of two full distribution events with eight total videos. For the version 1 ($n = 8$), instead of completing test trial 1, after infants watched distribution event 1 they were presented with a novel actor offering a toy in the center of the screen along with one corresponding container directly below it. This alteration removed the infants' test 1 fair actor choice while maintaining an analogous motoric response to that of study 1. For the version 2 ($n = 8$), the second distribution event occurred immediately after the first distribution event, and only one test trial was administered immediately following the set of conflicting information in distribution event 2. Both versions of the task remove the possibility of the initial actor choice after distribution event 1 to influence their subsequent response after distribution event 2, while maintaining the same amount of information as presented in study 1.

Coding and reliability. Reliability coding has not been completed for Experiment 3, so all analyses use the primary coder's looking times.

Results

Attention to distribution videos. There were no differences found in overall attention between the two versions of the task ($t(14) = .592, p = .563, d = .316$), so the following results are collapsed across both versions. We first examined infants' attention to the distribution events in order to confirm that infants were able to encode the relevant initial and conflicting information concerning actors' fairness. Infants' attention to the distribution events was high ($M = 97.5\%, SE = .08\%$). There was a significant difference found between infants' attention to distribution event 1 and distribution event 2 ($t(15) = 2.81, p = .013, d = 1.45$). However, infants'

attention was high during both distribution events (distribution 1: $M = 99.5\%$, $SE = .02\%$, distribution 2: $M = 95.5\%$, $SE = .15\%$), and subsequent fair actor choices on the test trial were not associated with infants' attention to the distribution event 1 ($r(14) = .281$, $p = .292$) or distribution event 2 ($r(14) = -.127$, $p = .638$). This evidence suggests that the difference in infants' attention between distribution events did not affect responses on the subsequent test trial.

Infants' fair actor choices on test trial. To determine whether infants preferred the initial fair actor or the most recent fair actor, we examined infants' toy choice at test trial after receiving both sets of conflicting information. Infants' toy choice was coded as choosing the fair actor if they chose the toy from the actor who distributed crackers fairly most recently in distribution event 2. An exact binomial test indicated that infants chose the toy from the fair distributor at chance, with 8 out of 16 infants choosing the toy from the fair distributor, $p = 1$. These findings indicate that infants showed no systematic preferences on the test trial after receiving both sets of information consecutively, either for the actor that was initially fair or for the actor that was most recently fair.

Counterbalancing Variables. There were no effects of counterbalancing variables on looking time or infants' fair actor choices.

Discussion

Across 3 experiments, our goal was to assess infants' responses to counter-information in the domain of fairness. Overall, the results of this study indicate that infants form first impressions of others based on their concern for fairness: in Experiment 1 13- and 17-month-old infants preferred a fair actor over an unfair actor after viewing initial information. However, after viewing conflicting information, in which the roles of the actors were reversed, infants do not show a systematic preference for the original fair actor or the most recent fair actor. Although the

results from Experiment 1 suggested that infants' responses following the counter-information may interact with perseverative tendencies, the following experiments found that infants showed no systematic preference for either actor when the possibility of perseveration was removed. Additionally, there was no indication that memory was associated with whether infants stuck with their first impression in the fairness task.

These results leave open the question of why infants might choose fair and unfair actors at chance on the second test trial. One interpretation of the current findings would be that infants are weighing both sets of information equally, and thus are at chance in their actor choices after conflicting information. One possible future direction of this work would be to adjust the amount of information within the initial set and the subsequent set of counter-information such that they are not equal. For example, one could present infants with six instances of fair behavior by actor A and unfair behavior by actor B, followed by three instances of counter-information, to see if changing the ratio of initial information to counter-information changes how likely infants are to stick with their first impression. If infants are indeed weighing these sets of contradictory information against each other then altering the relative amounts of information will affect infants' choices at the second test trial. Alternately, another interpretation could be that infants are simply confused after receiving two conflicting sets of information, because infants' memory ability at 13- and 17-months might not be developed enough to hold two conflicting sets of information in memory simultaneously while acting on that information. In the current study we administered a memory task where we looked at relations between infants' memory ability and infants' responses to counter-information in the fairness task. However, there were limitations with this task. The memory task may not be a sensitive enough measure of memory to get at individual differences in memory ability. It is also possible that infants interpreted this task as

something other than a memory task, for instance an imitation task. Future studies can use more firmly established measures of infant memory to further explore whether memory ability is related to infants' reactions to counter-information.

Another interpretation of these findings is that infants at this age might not yet view the behaviors of others as dispositional. There is some evidence that infants may attribute dispositions to others (Song, Baillargeon & Fisher, 2005; Repacholi, Meltzoff, Toub & Ruba, 2016). However, both of these studies could be explained via simpler mechanisms. Future work could test infants' dispositional inferences by asking whether infants extend their expectations of the behavior of others across contexts. For example, one might test whether infants expect an actor who commits a valenced action (e.g. hinders another actor from climbing a hill) to commit another different action that is consistent with the valence of the first action (e.g. steals a ball from another actor). If infants expect an actor who performed a negatively valenced action to perform a different negatively valenced action, then that would support the idea that infants might view other's behavior as dispositional. A different explanation for these results is that 17-month-old infants do view some behaviors as dispositional, but they specifically do not see fairness as a dispositional behavior. Other studies have focused on infants' impressions of prosocial versus antisocial agents using events in which one agent hinders another person's goals and another agent helps another person's goals (Kuhlmeier, Wynn & Bloom, 2003). To test whether infants see other behaviors as more dispositional than fairness, you could use the paradigm from the current study but substituted the fairness clips with the helper/hinderer clips from the Kuhlmeier study. If the pattern of results then showed that infants stuck with their first impressions that would suggest that it is not that infants have a limitation in terms of making dispositional inferences, but they have a tendency to think certain types of behaviors are more

dispositional than others. It is also possible that viewing others' behavior as dispositional may actually be a developmental achievement driven by the development of language abilities. There is some evidence suggesting that children starting at 2 years of age might understand the concepts of dispositions, where toddlers of this age begin using descriptive language such as "nice", or "naughty" (Bretherton & Beeghly, 1982; Hood & Bloom, 1979). The onset of descriptive language could aid in the categorizing relevant social information in order to conceptualize dispositions in the first place.

Limitations

Although fairness is one domain in which to test this with infants, there are many other possibilities. One limitation of the current set of studies is that they test infants' responses to counter-information in only one domain. Although the current studies serve as a good starting point for future studies, even if the current studies resulted in positive findings one wouldn't be able to generalize them to another domain, and because the goal of this work is to measure infants' first impressions generally then one would need to investigate infants' responses to counter-information in more than one domain. Another limitation of the current work is that infants' preferences were measured after receiving equal amounts of initial information and counter-information. Chance performance could either reflect a rational weighting of both sets of conflicting information, or it could reflect random responding. Another limitation is that infants' memory ability was measured with a novel memory task. Although this task was ecologically valid, it was not a validated measure of infants' memory ability and thus it is difficult to evaluate whether this memory task actually measures infant memory ability. An additional limitation is that, although the sample size in the current studies is in line with other infant literature, the current studies could have employed a larger sample size. Given that small sample sizes may

either underestimate or overestimate effects, it would be important to conduct future studies with larger sample sizes.

Conclusions

Adults form rapid impressions of others, and they stick to their first impressions despite counter-information. Although there is evidence that children and infants form impressions of others as well, little is known about what happens when they encounter conflicting information about others. The current set of studies extended prior findings that infants rapidly form impressions based on other people's fair or unfair behavior. However, when provided with counter-information infants were not systematic in their selection of either actor (i.e. infants were at chance when choosing the previously fair versus currently fair actor). Although future research is needed, these findings are consistent with the possibility that dispositional inferences are either less well-formed in infants versus adults, or have yet to fully develop by the middle of the second year of life.

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