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Infants' preference for individual agents within chasing interactions

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ABSTRACT

Infants, like adults, are able to discriminate between chasing and non-chasing interactions when watching animations with simple geometric shapes. But *where* infants derive the necessary information for discrimination and *how* chasing detection influences later visual attention has been previously unexplored. Here, using eye tracking, we investigated how 5- and 12-month-old infants ($N = 94$) distribute their visual attention among individual members within different interactions depending on a type of interaction. Infant gaze was examined when observing animations depicting chasing and following interactions compared with animations displaying randomly moving shapes. Results demonstrate that when observing chasing and following interactions, all infants strongly preferred to attend to the agent that initiates an interaction and trails behind another. Low-level features, such as changes in agent-specific velocity profiles, could not account for this preference (Study 2). Rather, the strong preference for the agent going behind seems to be dependent on the *initial* goal-directed or "heat-seeking" motion of one agent toward another (Study 3). The current set of experiments suggests that, similar to adults, 5-months-olds' visual attention depends on the motion features of an individual agent within the interaction and is fine-tuned to agents that display goal-directed motion toward other agents.

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Introduction

Causal relations are essential in comprehending an entire range of external events such as understanding the effect of one's own manual actions or understanding an object's motion trajectory when it collides with another. Whereas some types of causal relations, such as launch-and-collision events, involve direct physical contact, other types of interactions do not. This is typically the case for social exchanges. Correctly identifying such non-contact causal relations holds a great benefit in fostering learning about social interactions and the intentional agents that display them (Schlottmann & Surian, 1999). Previous studies have shown that infants detect information necessary for categorizing entities as intentional (Biro, Csibra, & Gergely, 2007; Johnson, 2003; Johnson, Slaughter, & Carey, 1998; Premack, 1990). However, no study to our knowledge has examined how non-contact causal relations guide attention to specific agents, informing what information is actively prioritized when observing interactions between animate agents. Limited visual displays, such as animations with multiple self-propelled moving geometrical shapes, provide a promising way to investigate this question.

Previous studies have demonstrated that when presented with such limited visual displays, adult observers attend to an object's motion as it relates to others and perceive the object as an animate entity (Castelli, Happé, Frith, & Frith, 2000; Gergely, Nádasdy, Csibra, & Bíró, 1995; Heider & Simmel, 1944). When asked to report what they have observed, adults consistently describe the geometric shapes as anthropomorphized entities moving in an intentional, goal-directed manner—the ball *wants to get, tries to catch,* and *runs away* from another.

Although there are many types of perceivable interactions, here we specifically focused on chasing interactions. Chasing interactions are, in an evolutionary sense, one of the most relevant animated percepts (Kanizsa & Vicario, 1968) and have been previously studied in both adults (Gao, Newman, & Scholl, 2009; Meyerhoff, Huff, & Schwan, 2013; Meyerhoff, Schwan, & Huff, 2014; Scholl & Gao, 2013) and infants (Frankenhuis, House, Barrett, & Johnson, 2013; Rochat, Morgan, & Carpenter, 1997). This type of interaction involves agents that have a relatively simple spatial relationship (one is ahead and one is behind), making it favorable to study because it is easy to detect, it does not require turn taking or role shifting, and the interaction can be extended in time without repeating. Although chasing interactions tend to be attention grabbing for participants of all ages, these three factors allow it to be studied with very young infants.

In a typical chasing interaction, one object moves toward another in a direct path while its target speeds up to move away when the chasing object gets too close. Adult observers readily identify chasing (Meyerhoff et al., 2013, 2014) and interpret it in goal-directed terms (Dittrich & Lea, 1994; Heider & Simmel, 1944; Morris & Peng, 1994). More recently, adult research has focused on determining *how* chasing detection takes place. In one study, Meyerhoff and colleagues (2014, Experiment 4b) presented adults with a chasing pair of objects embedded in 10, 15, or 20 identical distractors. After running series of controls, the authors concluded that of the two interacting objects, adults are more biased toward the chasers, or the objects that move toward other objects, than toward the objects being chased. In other words, they were faster at identifying an object that approached another from among distractors than identifying an object that was being approached. Other research (Scholl & Gao, 2013) corroborated these findings, showing that for adult observers the chaser, not the chase, is more attentionally salient.

Infants, much like adults, have been found to discriminate between chasing and non-chasing events (Rochat et al., 1997). One of the best examples examining early sensitivity to relational information between objects through motion is in the reactions to schematic action-and-reaction sequences. Through their work, Schlottmann, Ray, and Surian (2012) showed that the ability to detect differences in these types of non-contact causal relations emerges between 4 and 6 months of age. At 5 months infants show post-habituation recovery to changes in the spatiotemporal motion features, and by 6 months infants also become sensitive to changes in the perceived causality during simple action–reaction events as well as to the reversal of the causal structure.

Similar sensitivity to changes in causality has also been demonstrated with infants toward the end of their first year (Schlottmann & Surian, 1999; Schlottmann, Surian, & Ray, 2009). Using more complex chase-and-escape sequences, 8- to 10-month-old infants were habituated to a chasing interaction