



Original Articles

Human infants' understanding of social imitation: Inferences of affiliation from third party observations



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ABSTRACT

Imitation is ubiquitous in positive social interactions. For adult and child observers, it also supports inferences about the participants in such interactions and their social relationships, but the origins of these inferences are obscure. Do infants attach social significance to this form of interaction? Here we test 4- to 5.5-month-old infants' interpretation of imitation, asking if the imitative interactions they observe support inferences of social affiliation, across 10 experimental conditions that varied the modality of the imitation (movement vs. sound), the roles of specific characters (imitators vs. targets), the number of characters in the displays (3 vs. 5), and the number of parties initiating affiliative test events (1 vs. 2). These experiments, together with one experiment conducted with 12-month-old infants, yielded three main findings. First, infants expect that characters who engaged in imitation will approach and affiliate with the characters whom they imitated. Second, infants show no evidence of expecting that characters who were targets of imitation will approach and affiliate with their imitators. Third, analyzing imitative interactions is difficult for young infants, whose expectations vary in strength depending on the number of characters to be tracked and the number of affiliative actors to be compared. These findings have implications for our understanding of social imitation, and they provide methods for advancing understanding of other aspects of early social cognitive development.

1. Introduction

Human infants face the basic but critical task of learning about the social beings around them. Who is related to whom, and how? The task of learning about social beings may be especially difficult, because much social behavior—both gestures and speech—depends in part on arbitrary, conventional relations that must be learned (e.g., the words and hand gestures that signal the start of an interaction [“hi!”; a waving hand] and its end [“bye bye!” a flapping hand]). Some social behavior, however, relies not on the specifics of the actions but on the relationship between the social partners' behavior. One such behavior is the imitation, by one party, of another person's action. Imitation is a universal language for expressing social engagement, because one can only systematically imitate the behavior of another person if one is attending to that person. If the imitated behavior serves no clear instrumental function, moreover, then its performance suggests that the imitator is motivated not only to attend to the target of imitation but to align with the target for social or communicative purposes. Here we use studies of young human infants to probe the origins and nature of the social and communicative functions of imitation, asking how infants interpret

imitative interactions they observe as third parties. Do young infants use patterns of imitative behavior to attribute social motives to the partners in that interaction? In particular, do infants attribute prosocial motives to imitators, expecting imitators to affiliate with the targets of their imitation?

1.1. Prosocial imitation and development

Adults often signal their attention to and understanding of another person's speech by imitating the person's words and intonation either directly (“OK, two espressos”) or indirectly (“Copy that.”) Even in the absence of such overt communicative motives, however, imitation and mimicry are common, spontaneous components of social interaction that both reflect and elicit liking and prosocial behavior in adults (Bernieri, 1988; Chartrand & Bargh, 1999; Lakin & Chartrand, 2003; Sinclair, Lowery, Hardin, & Colangelo, 2005) and children (Kinzler, Corriveau, & Harris, 2011; Thelen, Dollinger, & Roberts, 1975). Children and adults appear to use imitation and mimicry as social tools, as they increase their copying behavior in the presence of desirable social partners or when the threat of ostracism enhances the drive to affiliate

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(Lakin, Chartrand, & Arkin, 2008; Over & Carpenter, 2009; Watson-Jones, Whitehouse, & Legare, 2016; Williams, Cheung, & Choi, 2000). In third party contexts, children and adults who witness acts of imitation make a variety of inferences about others' characteristics and relationships. For example, adults find those who mimic friendly rather than condescending social partners to be more competent, and those who mimic honest rather than dishonest social partners to be more trustworthy (Kavanagh, Suhler, Churchland, & Winkielman, 2011; Kavanagh et al., 2013). Five-year-old children infer social attitudes from imitation, judging an imitator to like the individual she copied more than an individual she chose not to copy (Over & Carpenter, 2015). By middle childhood, therefore, participation in imitation is accompanied by an intuitive, likely implicit, conception of imitation as a social gesture. To date, however, the origins of this conception are unknown.

A tendency to imitate and to respond positively to the imitative acts of others extends to infants. When faced with an attentive adult, neonates imitate a limited range of the adult's facial expressions (Field, Woodson, Greenberg, & Cohen, 1982; Meltzoff & Moore, 1977) and 3- to 5-month-old infants imitate a limited range of vocal expressions (Kuhl & Meltzoff, 1996), though the interpretation of these behaviors has raised controversy (see Oostenbroek et al., 2016; Ray & Heyes, 2011). Imitation of both movements and vocal sounds becomes increasingly flexible and robust during the first year of life (Barr, Dowden, & Hayne, 1996; Jones, 2007; Meltzoff, 1988). Shortly after their first birthdays, infants copy the behaviors of in-group members more closely than those of out-group individuals (Buttelmann, Zmyj, Daum, & Carpenter, 2013; Howard, Henderson, Carrazza, & Woodward, 2015). They also respond positively to being imitated, smiling more at an imitator than at a contingent social partner who does not imitate them, and helping more after being imitated by a friendly adult (Agnetta & Rochat, 2004; Carpenter, Uebel, & Tomasello, 2013; Meltzoff, 1990). One-year-old infants also treat imitation as evidence of a robot's capacity for social engagement (Meltzoff, Brooks, Shon, & Rao, 2010). This research does not reveal, however, whether such infants possess an understanding of imitation that allows them to make the sorts of third party social inferences made by children and adults.

Studies of one-year-old children also do not shed light on the origins of an understanding of social imitation. The earliest imitative behavior may reflect only asocial sensory-motor associations; infants may come to endow imitation with social meaning by experiencing social interactions in which they are the initiator or the recipient of an imitative action (Cook, Bird, Catmur, Press, & Heyes, 2014; Jones, 2006). Alternatively, the infant's own imitative behavior may be social from the beginning, and supportive of social inferences (Meltzoff & Moore, 1992). Imitation is one of the very few communicative gestures used by adults that infants might, in principle, understand, because it does not require mastery of any culture- or language-specific conventions. Studies of young infants' interpretations of imitation thus may shed light on infants' social cognitive abilities more generally. We therefore investigate whether infants endow observed imitation with social meaning before they begin to engage in robust, socially motivated imitation of their own interactive partners.

Across these studies, we also ask whether the social information that infants gain from imitation applies symmetrically or asymmetrically to imitators and their targets. If infants view imitation simply as evidence that the target and imitator are similar, then they might make symmetrical social inferences about imitators and their targets. In contrast, if infants view imitation as a social behavior reflecting the imitator's attention and/or motivation then infants' inferences about imitators and their targets might differ. Although an imitator signals her social attention and motivation toward a target by her act of imitation, the target of imitation makes no such signal, if she does not respond to the imitator in turn.

1.2. Current studies

We report a series of experiments measuring the visual attention of 4- and 5-month-old infants who are presented with acts of imitation and social affiliation, together with one experiment conducted with 12-month-old infants. We use these patterns of attention to ask whether, after observing a series of imitative and non-imitative interactions, infants expect imitators and/or the targets of imitation to approach and affiliate with their partners in the imitative interaction. To convey imitation, we present characters who copy other characters' movements or sounds. To convey affiliation, we use approach followed by synchronous motion. Approach is a basic behavior that is prompted by and indicates attraction to a person or object for adults (e.g. Cacioppo, Priester, & Berntson, 1993; Chen & Bargh, 1999) and infants (Gergely, Nádasdy, Csibra, & Bíró, 1995; Martin, Vouloumanos & Onishi, 2012; Sommerville & Woodward, 2010; Woodward, 1998;), and it has been used to test for expectations of positive social attitudes in infants (Hamlin, Wynn, & Bloom, 2007; Kuhlmeier, Wynn, & Bloom, 2003). Synchronized motion by animate characters also prompts social affiliation in adults (Hove & Risen, 2009) and infants (Cirelli, Einarson, & Trainor, 2014), and it is interpreted by infants as a sign of social affiliation (Powell & Spelke, 2013). By testing for expectations of approach and/or synchronous motion, therefore, we ask whether infants infer that imitators possess positive attitudes toward the targets of their imitation and vice versa.

Experiments 1a and 1b tested whether infants expect an individual character who has imitated one pair of characters to affiliate with that pair relative to a different pair it did not imitate. Experiment 2a extended this question by testing whether infants respond similarly when, following the same imitative interactions, the pairs approach and affiliate with the individual instead. Experiment 2b reversed the roles of the individual and pairs in the imitative interactions (i.e. as imitators versus targets of imitation) and then tested separate groups of infants on trials in which either the individual or the pairs played the approaching role (see Fig. 1). Experiment 3 tested for developmental changes in infants' interpretation of these events, with an experiment similar to Experiments 1a and 1b. Experiments 4 and 5 investigated the same questions in the context of dyadic interactions. In Experiments 2 and 4, moreover, some conditions presented test trials in which one actor approached two different parties, testing infants' inferences concerning the approacher's likely social goals or attitudes. Other conditions presented two different parties who both approached the same character, testing infants' inferences regarding who will initiate the affiliative interaction.

The experiments have three notable features. First, they depict imitation and affiliative events using animated characters consisting of geometric shapes with faces that move spontaneously and produce sounds. Such characters readily elicit mental state and social inferences in adults, children and infants when they move in a self-propelled and goal-directed manner (Hamlin et al., 2007; Heider & Simmel, 1944; Johnson, Dweck, & Chen, 2007; Kuhlmeier et al., 2003; Mascaro & Csibra, 2012; Over & Carpenter, 2009; Powell & Spelke, 2013; Schachner & Carey, 2013; Thomsen, Frankenhuys, Ingold-Smith, & Carey, 2011). Indeed, neurotypical individuals default to animate, social perceptions of simple shapes when presented with contingent, complex, and self-propelled behaviors (e.g. Castelli, Happé, Frith, & Frith, 2000; Heider & Simmel, 1944). We thus chose novel, artificial sounds and movements that nevertheless are likely to be perceived by infants as voluntarily generated by animate entities (Powell & Spelke, 2013).

By presenting computer-animated stimuli as opposed to live, videotaped, or puppet-based displays, we can assure that all experimenters are naïve to the events seen by individual participants throughout the execution of the study. We also gain greater control over

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