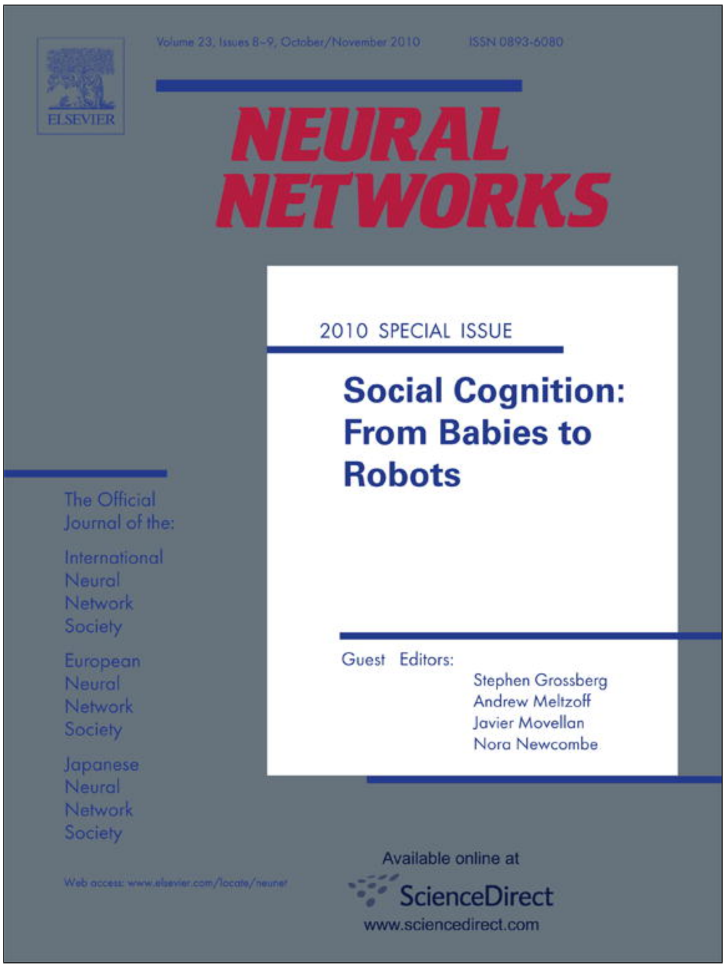
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Behaving as or behaving as if? Children's conceptions of personified robots and the emergence of a new ontological category

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ABSTRACT

Imagining another's perspective is an achievement in social cognition and underlies empathic concern and moral regard. Imagination is also within the realm of fantasy, and may take the form of imaginary play in children and imaginative production in adults. Yet, an interesting and provocative question emerges in the case of personified robots: How do people conceive of life-like robots? Do people imagine about robots' experiences? If so, do these imaginings reflect their actual or pretend beliefs about robots? The answers to these questions bear on the possibility that personified robots represent the emergence of a new ontological category. We draw on simulation theory as a framework for imagining others' internal states as well as a means for imaginative play. We then turn to the literature on people's and, in particular, children's conceptions of personified technologies and raise the question of the veracity of children's beliefs about personified robots (i.e., are they *behaving as* or *behaving as if*?). Finally, we consider the suggestion that such personified technologies represent the emergence of a new ontological category and offer some suggestions for future research in this important emerging area of social cognition.

1. Introduction

People imagine about others all the time—imagining what others are thinking and feeling, their desires and hopes, their motivations and aims. Imagining another's perspective is an achievement in social cognition and underlies empathic concern and moral regard (Baldwin, 1899/1973; Meltzoff, 2007). Imagination is also within the realm of fantasy, and may take the form of imaginary play in children and imaginative production in adults (Taylor, 1999). Framed in this way, imagining can been seen to fall along a continuum that spans from imagining others' internal states to generating imaginary personas and storylines.

Personified robots are designed with a personality (either human- or animal-like) and interact with people in seemingly intelligent and social ways. Do people conceive of personified robots as subjects with internal states and perceptual experiences? Or are any such attributions simply a product of the imagination, in the sense of pretense? These questions bear on a suggestion that a new technological genre may be emerging that challenges traditional ontological categories (e.g., between animate and inanimate) (Kahn, Freier, Friedman, Severson, & Feldman, 2004). To address these questions, we draw upon simulation theory and neuroimaging research as a framework for imagination as a means to understand others' internal states as well as to engage in fantasy and imaginary play. We then examine children's conceptions of personified robots. In light of this research, we raise the question of whether children are pretending when making attributions to robots (i.e., are they *behaving as* or *behaving as if*?). With that background, we then consider the possibility that such personified technologies represent the emergence of a new ontological category and offer suggestions for future research in this fascinating and emerging area of social cognition.

2. Imagining about others

The development of understanding others' minds occurs most markedly in the preschool years. Children come to understand that other people have intentions, desires, thoughts, and emotions, and that these may differ from their own. Theory–theory holds that children's understanding of others' mental states are conceptually framed or "theory-like" and undergo continuous refinement in the face of new information (Gopnik & Meltzoff, 1997; Wellman, 2002). In contrast, simulation theory proposes that children's understanding of others emerges from their own experience

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and, over the course of development, children learn not only to project their own states onto others, but also to account for others' perspectives and situations (Harris, 1992). Neuroimaging research suggests people may experience another's pain like their own, while maintaining a distinction between self and other (Jackson, Rainville, & Decety, 2006). People can also imagine pain they have never experienced, wherein empathy provides the bridge between the absence of experience and imagining others' internal states (Danziger, Faillenot, & Peyron, 2009). Thus, children are not limited to their actual experiences; they can take another's perspective by projecting oneself into another's situation, imagining how that person would feel, and then attributing that experience to the other agent (Carruthers & Smith, 1996; Decety & Jackson, 2004; Harris, 1992; Wellman, 2002).

An account of simulation theory can be traced back to Baldwin's dialectic theory of the development of the "socius", or social self (1892, 1899/1973). In the initial 'projective' process the child has yet to distinguish between self and other, which gives way to the 'subjective' process wherein the child incorporates previous experiences into an understanding of self as distinct from others, and in the final 'ejective' process the child understands a correspondence between self and other and ejects their experiences onto the other.

Harris (2000) proposes that children use the same process of simulation in imaginary play by simulating the perspective of the character they are portraying. The literature supports such a claim. Children with imaginary companions tend to perform better on theory of mind tasks (Taylor & Carlson, 1997), have advanced language skills, advanced self-control, and tend to be more social than their counterparts without imaginary companions (Singer & Singer, 1990). In addition, children with imaginary companions have better mental representation abilities and are more facile in engaging in pretend play compared to children without imaginary companions (Taylor, Cartwright, & Carlson, 1993). This pattern of results suggests that imaginary play is positively related to understanding others' internal states.

3. Conceptions of personified technologies

Sophisticated and intelligent technologies are increasingly becoming a part of children's lives and may, in turn, impact how children conceive of the world (Kahn et al., 2004; Turkle, 1999). Robots will undoubtedly become more life-like: autonomous (insofar as they initiate action), adaptive (respond appropriately to their social and physical environment), personified (convey an animal or human persona), and embodied (computation embedded in the entity) (Breazeal, 2003). It is possible that children will understand and treat such robots as having life, mental states, emotions, sociality, and moral worth (Kahn et al., 2004).

To provide some context for understanding children's conceptions of personified robots, we first provide a summary of the literature on the animate–inanimate distinction. Children discriminate between animals and artifacts on several dimensions. By the age of 24 months, children think artifacts are not capable of self-generated motion as evidenced by their surprise when artifacts move on their own (Gelman & Spelke, 1981; Gelman & Gottfried, 1996). 3- and 4-year-olds distinguish between the source of self-generated movement in animals and artifacts: The cause in animals is immanent or inherent, whereas movement in artifacts is a result of a mechanism, such as batteries or electricity (Gelman & Gottfried, 1996). In addition, 3-year-olds attribute biological characteristics, such as growth, reproduction, breathing, inheritance, and internal organs, to animates but not to inanimate entities (Gelman, 2003; Greif, Nelson, Keil, & Gutierrez, 2006). Children also distinguish between animate and inanimate entities with regard to psychological properties (e.g., 3-year-olds understand that animates can have feelings, whereas inanimates cannot) (Gelman & Spelke, 1981).

3.1. *Children's conceptions of personified robots*

Technologies that mimic human or animal characteristics pose an intriguing categorization challenge (Gelman & Spelke, 1981; Gelman & Opfer, 2002). Research indicates children attribute some but not other characteristics to robots, cutting across prototypic categories of animate and inanimate. Most notably children as young as 4-years-old rarely attribute biological properties or aliveness to a robot, yet still affirm perceptual and psychological capabilities, such as having cognition and emotions (Jipson & Gelman, 2007; Nigam & Klahr, 2000). These seemingly incongruous conceptions do not necessarily disappear with development: Five-year-olds believed that people have brains, but robots do not, whereas 7- and 11-year-olds believed the robot had a brain, although not identical to a human brain (Scaife & Van Duuren, 1995). Experience with robots is similarly associated with more nuanced views. Children with more prior experience with robots were *less* likely to judge it as alive, but *more* likely to judge it as intelligent, and intelligent in a unique way distinct from human or animal intelligence. Conversely, children with little prior experience believed the robot was both alive and had intellectual and psychological properties (Bernstein & Crowley, 2008).

In an observational study, preschool children who interacted with a robot dog as part of the experimental protocol readily engaged in reciprocal play with the robot, and 25% of them attributed animacy to the robot, 50% judged it to have biological properties, and 66% accorded mental states, social rapport, and moral standing to the robot (Kahn, Friedman, Perez-Granados, & Freier, 2006). In another study in which 7- to 15-year-olds interacted with a robot dog, researchers found they attributed a lot to the robotic dog: 21% said it was alive, 74% said that it could have feelings, 83% said it could be their friend, and 90% said it would not be all right to destroy the robot dog, and these results did not vary significantly across age groups (Melson et al., 2009).

3.2. *Adult social behavior with computers*

How unique are children's conceptions of personified technologies? Nass and colleagues reported that adults respond socially to computers that display minimal social cues, and do so in a manner surprisingly consistent with interpersonal interactions documented in the social psychology literature (Nass & Moon, 2000; Nass, Moon, Morkes, Kim, & Fogg, 1997; Reeves & Nass, 1996). For example, adult participants (a) responded more positively to computers that offered flattering comments regarding the person's performance on a task (Nass et al., 1997), (b) provided more polite feedback about a computer tutor when asked directly by the computer compared to a pen-and-paper feedback form (Nass, Steuer, Tauber, & Reeder, 1993); and (c) perceived gender, personality, emotions, and ethnicity in voice agents and were more attracted to voice agents that were most similar to themselves (i.e., similarity attraction) (Nass & Brave, 2005). These findings are surprising given that, when asked, these same participants judged that it is inappropriate to attribute human traits or characteristics to computers (Nass & Moon, 2000). Thus, while adults do not explicitly anthropomorphize computers, their behavior suggests quite the opposite. Nass and colleagues have termed this inconsistency between social behavior and judgment *ethopoeia*, where individuals respond to an entity as human while judging that the entity is not human or does not warrant human consideration (Nass et al., 1993).

4. Behaving as or behaving as if?

Is it the case that people are simply behaving *as if* when making attributions or engaging socially with personified technologies? Nass and Moon (2000) argued that adults mindlessly (and inappropriately) apply human–human social scripts to their interactions with computers, akin to Zelazo's (2004) Levels of Consciousness theory. It is only when called upon to reflect on their behavior that their attributions are weighed more cautiously. Clark (1996, 2008) argues instead that adults are *acting as if* the computer is a social actor, a form of *nonserious language* comprised of layers that on one level involve making an assertion and on another level involve jointly pretending that the assertion is true (see also Bruner, 1990). What is important to note, however, is that Clark assumes the imagined state is deliberate insofar as people are aware of acting as if in the same way that children engaging in joint pretense are aware of the real and imagined states.

Clark's point is well taken. Like adults, children engaged with robots in social ways (e.g., reciprocal interaction), but, unlike most adults, children often accorded robots various attributes typically reserved for people or animals (e.g., mental states, emotions, and moral standing). Is it the case that children are pretending when making these attributions to robots?

Pretend play is one of the hallmarks of childhood, and children regularly endow objects with imagined personas and capabilities (Harris, 2000; Singer & Singer, 1990; Taylor, 1999). Roughly two-thirds of children ages 3–7 years engage in imaginary play, which includes character impersonation, invisible companions, and personification of objects, and they do so with equal frequency throughout this period (Taylor, Carlson, Maring, Gerow, & Charley, 2004). Not surprisingly, the prevalence of imaginary companions declines with age, with approximately one-third of 9-year-olds and only 9% of 12-year-olds reporting having imaginary companions (Pearson et al., 2001). The type of role play also changes with age; preschoolers were equally divided between invisible companions and personified toys, whereas 6- to 7-year-olds were twice as likely to have invisible companions than personified toys (Taylor et al., 2004). Thus pretense ("as if") cannot be readily dismissed when interpreting children's attributions to personified robots.

Yet there are good reasons to consider that children are not engaging in pretense with robots. A central consideration is the issue of creative control, which can be understood along a continuum. Harris (2000) theorized that imaginary play involves a dual process of simulation and projection, in which the child projects a persona onto an object. In projection of a novel entity, whether real or imaginary, children have complete control and exhibit creative license (Taylor & Carlson, 2002). However, in the case of personified robots, the persona is embedded within the technology and therefore is not simulated and assigned by the child. This is also the case with "pre-packaged" fictional characters, such as Batman or Cinderella, encountered in storybooks and television. Children's pretense with fictional characters is typically in the form of impersonation (Carlson & Taylor, 2005). Thus, entities with embedded personas, whether a fictional character or a personified robot, are poorer candidates for a child's creative control. If, however, a child were involved in building or controlling a robot, and thereby assigning its persona, the limitations of creative control may well be overcome and manifest in a way similar to personification of inanimate objects.

Consideration must also be given to children's ability to distinguish between fantasy and reality; that is, children's attributions to robots may reflect confusion about the ontological status of robots rather than engagement in pretense. When fictional characters are encountered in real life, for example at Disneyland, children can easily slip into a willing suspension of disbelief (Madhani, 2009; Walton, 1990). Nevertheless, as realistic and compelling as a real-life portrayal of a fictional character may be, both children and adults recognize the fictional nature of characters. In fact, from about the age of 4 years children understand that fictional characters are not real (Corriveau, Kim, Schwalen, & Harris, 2009; Woolley & Cox, 2007; Woolley & Van Reet, 2006). A notable exception is "imaginal" characters, such as Santa Claus or the Tooth Fairy, which are not physically present, but are experienced as real nonetheless, in large part due to adult encouragement (Dell-Clark, 1995; Sharon & Woolley, 2004; Woolley, Boerger, & Markman, 2004). Children and adults can and do experience emotional responses to fictional characters and stories (Harris, Brown, Marriott, Whittall, & Harmer, 1991). Yet, as Harris (2002) argued, emotional arousal is not convincing evidence for a failure to distinguish between fantasy and reality.

Whether and to what extent children engage in pretense when making attributions or interacting with robots remains to be ascertained. It may be that children are behaving *as if* or, more provocatively, that they are behaving *as*. We take up the latter possibility next.

5. Emergence of a new ontological category

One possibility is that children's attributions to personified robots reflect the emergence of a new ontological category (Kahn et al., 2004). Accordingly, children will understand and interact with personified robots as unique entities that are neither alive nor not alive, but something altogether different. Ontological categories reflect fundamental and parsimonious distinctions between the broadest classes of entities (Thommason, 2009; Wittgenstein, 1953/2001). These categories are cast abstractly enough such that they reflect fundamental differences between entities without being piecemeal or arbitrary, yet not so broad that they fail to capture what is essential to the category (Gelman, 2003).

At least five forms of evidence are necessary (and are ripe areas for future research) to support the suggestion that a new ontological category has emerged. Namely, attributions to robots must cut across prototypic categories (e.g., alive or not alive). Initial evidence suggests that a strict distinction between animates and inanimates fails to accurately capture children's conceptions of robots, judgments that appear to be more nuanced and multifaceted (Jipson & Gelman, 2007). Personified robots are understood as possessing a unique constellation of properties, such as perception, intelligence, feelings, volition, and moral standing, while simultaneously being understood as mechanical rather than biological (Bernstein & Crowley, 2008; Jipson & Gelman, 2007; Kahn et al., 2006; Melson et al., 2009; Scaife & Van Duuren, 1995).

It is an open question whether such attributions to robots reflect children's or adults' actual as opposed to pretend beliefs. Yet, evidence of pretense would undermine the possibility that a new ontological category has emerged as ontological categories rather reflect *actual* distinctions between entities. An initial line of research could focus on children's engagement in pretense when making attributions of prototypically animate characteristics to robots. Subsequent questions could then be addressed, including whether (a) known correlates of pretense (e.g., theory of mind) (Taylor & Carlson, 1997) are associated with high levels of attribution to personified robots; (b) children have different levels of commitment to their attributions, which may change across development and/or correspond with their propensity and facility for pretense (Carlson, 2010); and (c) children's engagement in pretense differs across judgments and interactions, as is the case with adults' social interactions with computers (Nass & Moon, 2000). These issues could be investigated in the form of direct questioning or categorization tasks (e.g., sorting robots, people, and dolls into pretend, real, or both), implicit association measures (e.g., MacDorman, Vasudevan, & Ho, 2009), and/or behavioral interactions (e.g., Kahn et al., 2006).

It may also be the case that the characteristics attributed to robots reflect functional, rather than structural, correspondence to humans or animals. Some evidence already exists to support this possibility (e.g., robots are intelligent but in a way unique from humans; (Scaife & Van Duuren, 1995). A similar correspondence appears in the literature on human–nature interaction: Animals can be seen as functionally analogous to humans even if structurally different and this forms the basis for moral regard (e.g., a fish has gills, whereas a person has a nose, therefore preventing respiration to either is a moral violation; Kahn & Friedman, 1995). The assertion is that functional correspondence provides a basis for understanding a personified robot as an other.

A fourth form of evidence for the emergence of a new ontological category is that children's attributions to robots do not simply disappear with development. A developmental decline would suggest that earlier conceptions are inaccurate and only become more adequate (i.e., no attribution) with age. This is not to say that developmental differences would not occur. In fact, evidence already exists that meaningful differences emerge across development in the quality of children's understanding of robots. With development, children's attributions to robots did not disappear, but became more nuanced and sophisticated (Scaife & Van Duuren, 1995).

Finally, as robots become increasingly sophisticated and interactive, children may come to understand them in qualitatively different ways than previous generations. Consequently, a cohort effect may become apparent wherein children who come of age with increasingly sophisticated personified robots would be more likely to conceive of them as unique "subjects" (Kahn, Severson, & Ruckert, 2009). The most fruitful research would follow from cross-lagged longitudinal designs in order to examine developmental and cohort effects.

6. Conclusion

Personified robots will increasingly be a part of people's lives, thus raising provocative questions regarding how people, and especially children, will understand robots that are life-like in appearance and/or social interaction. One possibility is that people may mindlessly slip into social interaction with personified robots, but will judge that it is only an object not worthy of social consideration (Nass & Moon, 2000). Another possibility is that people will consciously act *as if* robots were social others without really believing that to be the case (akin to children's pretend play) (Clark, 1996, 2008). A third alternative is that robots represent a new ontological category (Kahn et al., 2004). Accordingly, people will understand them as possessing a unique constellation of social and psychological attributes that cut across prototypic ontological categories. This proposal takes seriously people's social interactions and conceptions of robots, rather than conceiving of people's attributions as simply a product of mindless behavior or pretense. Children are a particularly interesting population to investigate in this regard, as their developing understanding of the physical and social world will include personified robots. It may well be that a generational shift occurs wherein those children who grow up knowing and interacting with life-like robots will understand them in fundamentally different ways from previous generations. Thus, now and increasingly, children may imagine about robots — their thinking and feelings, their desires and hopes, their motivations and aims — and see them as others that are in many ways like them.

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