DEVELOPMENT AND CORRELATES OF ANTHROPOMORPHISM

by

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DISSERTATION ABSTRACT

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One of the most heavily researched topics of cognitive development concerns children's growing understanding of people's behaviors as reflecting mental states such as beliefs, desires and intentions. Anthropomorphism is the overextension of this conceptual framework, referred to as "theory of mind", to nonhuman animals and inanimate objects. In this dissertation, I investigate the development and correlates of anthropomorphism building on and extending past research with children and adults. In Study 1, I investigated the relation between anthropomorphism, social understanding, and social behaviors that are known to correlate with theory of mind, such as empathy, and prosocial attitudes in a college sample (N = 919). Contrary to my predictions, results showed that anthropomorphism is only weakly related to the measures of social understanding. There was, however, some evidence for a link between anthropomorphism and imaginary companions; individuals who had a history of imaginary companions scored higher on anthropomorphism. In Study 2, I examined the link between theory of mind and anthropomorphism in preschool children. In addition, I investigated the developmental trajectory of anthropomorphism from age 4 to 6 and the relation between anthropomorphism and role play and social preferences. Seventy-four children (36 girls;

M_{age} = 5 years, 5 months; *SD* = 9 months) took part in this study. In order to assess anthropomorphism in this age group, I used two methods: interview and movie narrative measures. Results revealed no age-related changes in anthropomorphism scores of the children. As in Study 1, I did not find a strong relationship between the theory of mind measures and anthropomorphism. There was, however, more evidence for a link between the interview measure of anthropomorphism and role play, and social preferences of children. Overall, in both studies, theory of mind, the most obvious candidate as a correlate of anthropomorphism, was, at best, not a strong predictor of the anthropomorphism, suggesting the need to rethink how developing knowledge about people is related to the overextension of this knowledge to nonhuman entities. It is possible that a rudimentary understanding of humans is necessary to be able to overextend it, but whether you overextend it might be linked to other factors.

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CHAPTER I

GENERAL INTRODUCTION

Overview

In the 2000 film *Cast Away*, a character played by Tom Hanks is marooned on an uninhabited island after he survives the crash of his Fed Ex plane. Among the many packages from the plane that wash up on the island's beach, one contains a volleyball that Hanks names "Wilson". In the absence of human companionship, Hanks develops an imaginary relationship with Wilson, and it is this friendship that sustains him during four long years of isolation. Ultimately, Hanks escapes, but Wilson is swept out to sea and lost in a scene that is devastating to Hanks and brings tears to the eyes of many audience members.

In some ways, it might seem odd that it is possible to care so much about the loss of a beat up volleyball. But we understand and empathize with Hanks' character because the attribution of human personality, emotions, beliefs, desires and intentions to inanimate objects is an everyday phenomenon. Children talk to their stuffed animals and adults talk to their cars. We readily understand that a lamp in a Pixar advertisement is excited and that a machine in a General Motors commercial is depressed. Our knowledge about the intentions, emotions, and beliefs of people is routinely overextended to nonhuman animals and inanimate objects, a phenomenon known as anthropomorphism.

In this dissertation, I investigate the development and correlates of anthropomorphism, building on and extending past research with children (Berry & Springer, 1993; Piaget, 1929; Springer, Meier, & Berry, 1996) and adults (Waytz, Cacioppo, & Epley, 2010). In Study 1, I investigated the extent that individual

differences in anthropomorphism predict social understanding, empathy, and prosocial behaviors in a college sample. Study 2 was designed to shed light on the development of anthropomorphism during the preschool years. To this end, I developed two measures to assess anthropomorphism in this age group and investigated developmental patterns, as well as correlates of each measure.

In this introductory chapter, I start by defining anthropomorphism and then reviewing theoretical perspectives and empirical studies of anthropomorphism in adults and children. Next, I describe how children come to understand other people as being guided by their mental states (i.e., theory of mind) and how this conceptual theory of mind framework for understanding people might be related to anthropomorphism.

Definition of Anthropomorphism

Anthropomorphism is the "attribution of capacities that people tend to think of as distinctly human to nonhuman agents, in particular humanlike mental capacities (e.g., intentionality, emotion, cognition)" (Waytz, Cacioppo, et al., 2010, p. 220). This definition distinguishes anthropomorphism from animism, which is the attribution of life to inanimate objects. Piaget (1929) sometimes used the term animism more liberally to also include anthropomorphic thinking (e.g., "animism during play [such as the endowment of personality to dolls]…", p. 207). Nonetheless he studied these constructs separately with different questions (e.g., he asked whether an object was alive to measure animism and asked whether an object knew or felt anything to measure anthropomorphism). He found that children are more selective in their attributions of life than they are with their attributions of mental states and that it is not unusual, at least for

children, to anthropomorphize without animating (e.g., denying life to a bicycle, but at the same time stating that it can feel the ground).

My stance on the relation between anthropomorphism and animism is probably most similar to the position of Guthrie (1993), who described animism and anthropomorphism as distinct but complementary processes that tend to co-occur. For instance, when we attribute intentions to an inanimate object, we are treating it as if it has a mind of its own (anthropomorphism) and as if it is a living being (animism). Although these processes usually occur together, there are cases in which we animate but do not anthropomorphize (e.g., stating that a car purrs like a kitten; Guthrie, 1993, p. 41) or anthropomorphize without animating (e.g., attributing mental states to a pet).

Theoretical Perspectives on Anthropomorphism

The tendency to think about nonhumans in humanlike terms –anthropomorphism– has often been described as universal and automatic (Guthrie, 1993; Hume, 1757/1956; Piaget, 1929). For example, Piaget claimed that children are born "with the idea of a universal life as its primary assumption" (p. 230). In Piaget's theory this perspective stems from the child's egocentricity; the external world is a continuation of the self and thus, it is natural for the child to over-extend self experiences to other agents (including humans and nonhumans). Via this extension, the child then conceptualizes agents as similar to the self in many respects including knowledge states, desires, and emotions (e.g., attributing feelings to inanimate objects). Piaget claimed that as children become aware of the difference between themselves and others in the world they come to understand that some agents are thinking and some are not, an insight that leads to a reduction in anthropomorphism.

The description of anthropomorphism as a natural process is also present in other theoretical accounts. For example, both Bloom (2007) and Guthrie (1993) describe anthropomorphism as natural, claiming that we have an implicit tendency to attribute agency and intentionality to a wide range of nonhumans (e.g., wind, cars, and leaves). However, one difference of these accounts from Piaget's is that Piaget believed that children grow out of anthropomorphism as they learn that self experiences are distinct from the rest of the world. Thus, in his view, the overextension of human states to nonhumans is an example of a primitive cognitive perspective reflecting an inability to distinguish self from others, and that it is corrected as children mature. On the other hand, both Guthrie and Bloom seem to think that adults, as well as children, are naturally inclined to attribute humanness to nonhuman entities.

Empirical studies with adults support Bloom and Guthrie's view that adults anthropomorphize, but that the view of anthropomorphism as universal and automatic is overstated. Some people anthropomorphize more than others (Chin, Sims, DaPra, & Ballion, 2006; Waytz, Cacioppo, et al., 2010) and some cultures are more anthropomorphic in their beliefs than others (Asquith, 1986). Recent research in social psychology by Nicholas Epley and his colleagues has been particularly influential in the literature and provides some of the inspiration for this dissertation. In what follows, I provide an overview of the theoretical perspective and empirical studies with adults by Epley and his colleagues, and then review developmental research on anthropomorphism, with a focus on the ideas of Jean Piaget.

Anthropomorphism Research with Adults

In a series of studies, Epley, Waytz, and Cacioppo (2007) examined the contexts in which people anthropomorphize and found that some situations trigger anthropomorphism more than others. They identified three factors (one cognitive and two motivational) that influence when people are likely to anthropomorphize. The cognitive factor is elicited agent knowledge, which refers to the activation of knowledge about humans. The extent that elicited agent knowledge is applied to nonhumans is moderated by two motivational factors: effectance motivation (i.e., the need to be understand, explain, and predict environment), and sociality motivation (i.e., the need to create social connections). Each of these factors will be discussed in turn.

Elicited Agent Knowledge

Being able to understand people as guided by their mental states (e.g., intentions, desires) is crucial in successful social interactions. This framework gives us ways to explain and predict behaviors. However, it is not always easy to infer the mental states of other people. In the cases where there is not enough information about the other person, we often rely on our *own* beliefs and experiences as anchors to predict mental states (e.g., assuming that the other person has the same knowledge as ourselves; Nickerson, 1999).

When we are interacting with nonhumans, we sometimes appear to recruit a similar strategy to understand, control and predict nonhuman agents' behaviors. As we rely on knowledge about *ourselves* when predicting other people's mental states, we might rely on knowledge about *humans* in general when attempting to understand and predict behaviors of nonhumans. This elicitation of knowledge about humans might be triggered by personal factors about the individual who is making the attributions (referred

to here as *perceiver triggers*). For example, anthropomorphism might be triggered when an individual has a well-developed framework for thinking about the behavior of people and a relative lack of knowledge about the nonhuman target to be explained. This might explain, for example, why children anthropomorphize more than adults. Early on, knowledge about people might serve almost as a default explanatory framework (e.g., Carey, 1985), but as children acquire knowledge about nonhumans, they might be more likely to activate their knowledge in the corresponding domain, rather than their knowledge about humans (e.g., learning about how the moon rotates in a physics class vs. stating that the moon is following the child to hear what he or she is saying). Adults also activate knowledge about humans in cases where they do not know much about the agent to be explained. For example, when a computer crashes, if the person knows a lot about computers, he or she might immediately think about what the possible physical causes could be (e.g., a power surge, problem with the hard-drive). However, a person who knows very little about computers might react with anger, experiencing the timing of the crash (e.g., when a deadline is approaching) as almost intentional. This is not to say that people really believe that their computers have vile intentions and are trying to sabotage their work. Rather, the claim is that people might anthropomorphize more when the agent is not well understood, making the unpredicted behavior of the agent feel more personal.

If people do not really believe in the mental states of a crashing computer, then, is it appropriate to think of anthropomorphism as a type of metaphor? Epley and colleagues (2007) address the question of whether people really believe in what they state when anthropomorphizing by making a distinction between strong and weak forms of

anthropomorphism. In strong forms, people do really believe that nonhumans have humanlike characteristics, as is the case in certain religious beliefs (e.g., believing that God is angry). However, in weaker forms, people use 'as-if' metaphorical reasoning, as in the above example of an evil computer. Metaphors are used as a way to understand abstract/unknown phenomena (Lakoff & Johnson, 1980) and it is not surprising that anthropomorphism serves a similar function. Epley et al. claim that although the strong and weak forms of anthropomorphism are distinct in the extent that they reflect individuals' beliefs in nonhumans' humanlike characteristics (e.g., believing in nonhumans' mental states as in the strong form vs. talking as if nonhumans have humanlike characteristics without really believing as in the weak form), both forms have a powerful impact on our behaviors and both can be explained by the same psychological mechanisms.

Knowledge about humans as a basis for interacting with nonhumans might also be triggered by *target* factors, such as the similarity of the agent's motion or appearance to humans. If an agent looks like a human, then this similarity triggers knowledge about humans, and makes people more likely to attribute human characteristics to that agent. For example, people are more likely to anthropomorphize when a nonhuman agent has a face, body, or motion that is humanlike (Epley et al., 2007; Johnson, 2003; Morewedge, Preston, & Wegner, 2007). In a study by Morewedge and colleagues (2007), participants were asked to rate several nonhuman targets (e.g., robots, geometric shapes) in the extent that they had humanlike characteristics (e.g., intentions, intelligence, thinking). Participants in the study were more likely to anthropomorphize nonhuman targets that

moved at speeds similar to the speed of natural human movement than targets that moved slower or faster.

Effectance Motivation

The extent that elicited agent knowledge is applied to nonhumans is moderated by one's motivation to understand, explain, and predict the agent's behaviors, referred to as "effectance motivation". Epley et al. (2007) state that people tend to use humans as a basis of knowledge especially when they want to have successful interactions with their environment.

The effectance motivation can be triggered by perceiver factors. People might be motivated to understand, explain, and predict their environment for different reasons. For example, people who score higher on 'need for control' and 'need for closure' measures (which assess the need to be in control of one's environment) anthropomorphize more than others - possibly due to their search for explanation in their interactions with humans and nonhumans. In a study by Epley, Waytz, Akalis, and Cacioppo (2008), people who had a stable need for control over their environment anthropomorphized animals that act unpredictably more than people who scored lower on the need for control measure.

In addition some situations motivate people to understand and predict their environment more than others. For example, people anthropomorphize more when it is beneficial to them to be able to predict another's behavior. In a study by Waytz, Morewedge, et al. (2010) participants watched short movies of a robot engaging in several behaviors (e.g., putting dishes away). The movies were stopped in the middle, and participants were given two options to choose from for the next action of the robot (e.g., it will either put the dishes in the drawers or it will put the dishes on the counter).

At the end of this session, participants reported the extent that the robot had a mind of its own, intentions, desires, consciousness, and emotional experiences. Participants were more likely to anthropomorphize the robot when they were offered monetary incentives to correctly predict the next action (e.g., $1 for each correct prediction) as opposed to when they were not offered incentives (e.g., not motivated) to predict (Waytz, Morewedge, et al., 2010).

The effectance motivation can also be triggered by characteristics of the nonhuman entity to be explained (i.e., target factors). For example, predictable behaviors of nonhuman agents can be explained easily without a need to believe in the existence of a free will in the agent (e.g., a computer shutting down when you unplug it). However, people are more likely to anthropomorphize when the target agent's behaviors are unpredictable (e.g., a computer shutting down suddenly for no apparent reason) (Waytz, Morewedge, et al., 2010).

Epley, Waytz, et al. (2008) found that when people were describing behaviors of two dogs (one behaving predictably, the other unpredictably), participants rated the unpredictable dog higher on anthropomorphic traits (e.g., having emotions) than the predictable dog. Similarly, gadgets that were described as unpredictable elicited higher ratings on anthropomorphic traits (Waytz, Morewedge, et al., 2010) and people who experienced unpredictable malfunctions with technology (e.g., their computers crashing as they are working on a project) anthropomorphized those agents more (e.g., attributing a mind to the agent). Overall, these results suggest that anthropomorphism might satisfy people's need for explanation by providing a rich knowledge base to draw on (e.g., intentions, personality attributes).

Sociality Motivation

The other motivational factor in triggering anthropomorphism is sociality – one's need to establish social connections with others. For the most part, being around and connecting with other humans satisfies this motivation. In cases where there is not sufficient social connection with other humans, people are more likely to create humanlike agents out of nonhumans (e.g., lonely people reporting a closer relationship with God).

Epley, Akalis, Waytz, and Cacioppo (2008) tested the sociality motivational factor in both correlational and experimental studies. In one study, participants were given descriptions of four unfamiliar technological gadgets and were asked to rate these gadgets on several attributes - some of which were anthropomorphic (e.g., having a mind of its own) and some were non-anthropomorphic (e.g., being strong). The results showed that people who reported being chronically lonely rated unfamiliar gadgets more highly on anthropomorphic attributes (i.e., having a mind of its own, having intentions, free will, consciousness, and experiencing emotions). In another study, participants were given a list of 14 traits, some of which were anthropomorphic (e.g., thoughtful) and some were non-anthropomorphic (e.g., active) and were asked to rank order the traits that best described their pets. Participants who self-reported being lonely provided higher rankings of the anthropomorphic traits for their pets (e.g., thoughtful, considerate, sympathetic) (Epley, Akalis, et al., 2008).

Epley, Akalis, et al. (2008) also tested the sociality motivation hypothesis by manipulating loneliness experimentally. In one study, half of the participants watched a movie depicting social disconnection (i.e., "*Cast Away*") and the other half watched a

movie inducing fear (i.e., "*Silence of the Lambs*"). Some of the anthropomorphic traits were those that would be 'social' (e.g., thoughtful), and the others did not relate to social behaviors directly (e.g., creative). Participants in the social disconnection condition rated their pets higher on anthropomorphic traits that were related to social connection and support (e.g., thoughtful, considerate) than the participants in the fear condition. Thus, it is not any negative emotion that triggers anthropomorphism. Consistent with the sociality motivation, only the social disconnection condition (not the fear condition) triggered anthropomorphism. Moreover, it was not the case that participants created any kind of humanlike agent from nonhumans; they anthropomorphized in ways that satisfied their need to be social, rating their pets higher on traits that are related to social connection and support.

Anthropomorphism Research with Children

Jean Piaget

To my knowledge, Piaget (1929) was the first psychologist to study anthropomorphism in children. His main interest was conceptual development, and one of the core areas of his study in this field was children's conceptualization of nonhumans (e.g., wind, fire, bicycles). He used the terms 'attribution of consciousness' and 'anthropomorphism' somewhat interchangeably in his writings. To keep the terms consistent throughout the paper, I will refer to Piaget's work on attribution of consciousness as anthropomorphism.

Piaget interviewed children (ages 4 to 12) to examine developmental change in children's attribution of life (i.e., animism) and anthropomorphism. He asked children whether a series of inanimate objects 'feel' or 'know' certain things. For instance, he

asked children whether the sun knows it gives light, whether a bicycle knows it goes, and whether buttons will feel it if we were to pull them off. In addition, Piaget asked children to explain their answers. For example, after children answered "*Can clouds feel a prick?"* he asked why they think that way and whether the object in question will feel or know in different contexts (e.g., *Why/Why not?, Can clouds feel the wind?*). Based on children's answers to these questions Piaget classified children into four stages.

Piaget's stage 1. In the earliest stage (lasting until about age 6-7 years), children tended to attribute knowing and feeling to nonhuman objects when "the object displays a particular measure of activity or is the seat of some action" (p. 174). For example, a child might deny the feeling of heat or cold to a stationary stone, but the same child might very well attribute feelings to a stone if it was dropped on the ground, because it is now associated with action (of any kind) and "*because it would break*". Similarly, a wall does not feel anything, but it would feel being knocked down. In this stage, any kind of activity associated with the object might trigger attribution of knowing and feeling.

Piaget's stage 2. In the second stage (lasting until about age 8-9 years), children narrow the extent of anthropomorphism to things whose function is to move (as opposed to solely being at the seat of an action for a moment). At this stage, movement of any sort, whether it is triggered from within or caused by external sources, triggers anthropomorphism. This stage is different from the previous stage because in the first stage, objects were attributed consciousness when any kind of activity was associated with the object (e.g., walls being knocked down, table being burnt in fire), but in this second stage children attribute consciousness only to objects whose functional properties include moving; the moon, sun, carts, and bicycles (e.g., when asked whether a bicycle

knows when it is going, the child answered, "*yes, (because) it feels the ground*"). In this stage, stationary objects which can only be at the seat of an action momentarily (e.g., benches, stones, flowers) are denied consciousness.

Piaget's stage 3. The child's discovery of the "existence of bodies whose movement is not self-governed" (Piaget, 1929, p. 181) marks the transition from the second to the third stage. In the third stage (lasting until about age 11-12 years) children narrow the extent of their attributions of feeling and knowing to things that can move on their own. In the third stage, when children are asked whether a bicycle knows when it is going, they answer no, and give an explanation that includes a reference to the external cause of the movement (e.g., "*because it has to be made to go*"). In this stage, children have a distinction based on *who* governs the movement – whether the motion is self-governed or caused by external factors. However, the child's understanding of self-governed movement is limited by their understanding of physics. For instance, when asked whether the wind knows it is blowing, the child who (inaccurately) believes that the wind blows on its own accord might answer 'yes'.

Piaget's stage 4. In the fourth and final stage, children make distinctions between living and nonliving things, and use this distinction to govern the attribution of consciousness – attributing feeling and knowing to animals alone or plants and animals alone. For instance, when asked what things can know and feel, a child in the fourth stage answered "*plants, animals, people, and insects*" (Piaget, 1929, p. 187). Similarly, when asked whether the sun feels anything, a child in the fourth stage again used his knowledge about living and nonliving, and claimed "*no, because it is not alive*".

More Recent Work with Children

Overall, the developmental story based on Piaget's interviews is that children start life by anthropomorphizing everything and as they get older they narrow the range of things they anthropomorphize. This pattern has been challenged by more recent empirical studies showing that adults actually anthropomorphize more than preschool children. Many of these studies make use of a movie created by Heider and Simmel in 1944 that was originally designed to assess whether people perceive the movements of nonhuman entities, geometric shapes in this case, in a way that is similar to social interactions of humans.

In the movie, two triangles and a circle move around the screen demonstrating self-propelled and contingent movement. According to Heider and Simmel, self-propelled and contingent movement of the objects trigger attributions of agency. When asked to describe the movie, 97 % of the adult participants attributed humanlike characteristics to these simple geometric shapes. Moreover, there was consistency in the social behaviors and mental states in participants' answers. For example, most narratives included attribution of mean intentions and bullying behavior to one of the triangles, and fear and anxiety to the circle and little triangle.

In a study by Berry and Springer (1993) only 56 % of preschool children (3-, 4-, and 5-year-olds) used anthropomorphic language in their narratives of Heider and Simmel's movie (e.g. "*The triangle is gonna get the circle."*) whereas 100% of adults in their earlier study described the events of the movie in anthropomorphic terms (Berry, Misovich, Kean, & Baron, 1992). These results suggest that there are individual

differences in children's anthropomorphism and that adults anthropomorphize more than children – a developmental pattern that is contradictory to Piaget's.

Developmental changes in anthropomorphism were investigated in another study in which preschool children and adults were shown the Heider and Simmel movie and asked forced-choice questions about each character (e.g., whether or not the character was mean) (Springer et al., 1996). Three and 4- year olds had difficulty identifying the psychological traits, emotions, and relationships of the characters, whereas 5-year-olds were similar to adults in their accuracy (e.g., reporting that the big triangle that hit the small circle was mean). The authors interpreted these results as suggesting that younger children's interpretations of interpersonal events based on perceptual cues differ from those of older children and adults, possibly reflecting developmental differences in social understanding. However, these results might also reflect differences in anthropomorphism. Younger children might be less able to extend a framework used to describe human interactions to the movements of geometric shapes. Alternatively, children might not have realized that the geometric shapes were meant to be interpreted anthropomorphically. They might describe what goes on in the movie in physical terms because they do not understand that describing geometric shapes in humanlike terms is an appropriate way to report what happened in the movie.

Anthropomorphism and Theory of Mind

Theory of Mind (ToM) is the understanding that unobservable mental states guide people's behavior (e.g., going to the store is guided by one's desire to get groceries and the belief that one can fulfill this desire by going to the store) and that these mental states might be different from one's own state (e.g., I might have a desire to get fruit from the

store and another person might like to get vegetables) and from the reality (e.g., although I believe the store has the fruit I want to buy, in reality the fruit might be out of stock). This theory of mind framework is an important intellectual achievement that develops during the preschool years, and is correlated with many important social behaviors such as empathy (Baron-Cohen, 1995), moral development (Killen, Mulvey, Richardson, Jampol, & Woodward, 2011), social competence and peer acceptance (Bosacki & Astington, 1999; Dunn & Cutting, 1999), and early success in school (Astington & Pelletier, 1996).

Anthropomorphism can be considered as an extension of the theory of mind framework to nonhumans. Thus, ToM development and individual differences are important in understanding the mechanisms underlying anthropomorphism. I first briefly review theory of mind development during the preschool years and then discuss its origins in infancy. The infant research is intriguing not only because of the results showing an early developing understanding of intentionality, but also because of the assumptions about anthropomorphism that are implicit in the methodologies. Finally, I will briefly discuss some findings from the literature on Autism Spectrum Disorders that provide additional evidence of a link between anthropomorphism and ToM.

Theory of Mind Development in Preschool Period

Children show striking changes in their understanding of mental states between the ages of 2 and 5 (Wellman, 1990). During this period, children develop an understanding that people might have mental states (e.g., beliefs, desires) that are different from the reality and those of others, which will guide their behaviors. Understanding false belief (i.e., a belief that does not reflect the true state of the world)

has been taken as a milestone in theory of mind development. This is because predicting another person's behavior as guided by their false beliefs requires understanding of that person's mental states as just a 'representation' of the world. This is in contrast to understanding of true beliefs (i.e., beliefs reflecting the true state of the world) which does not necessarily require understanding of beliefs as representing the world. For example, if I (falsely) believe that it will rain today I will take my umbrella with me even though it might be a sunny day in reality.

False belief tasks have been used as the gold standard for assessing theory of mind in preschool period. For example, in one classic false belief task (Wimmer & Perner, 1983), the child watches a character, Sally, leave chocolate in her basket and then leave the room. While she is out of the room, her friend Anne comes into the room, and changes the location of the chocolate from the basket to the box. The child is then asked where Sally will look for her chocolate when she returns to the room. Older preschoolers (ages 4-5) answer correctly by saying that Sally will look in her basket, because she left it there. Younger children, on the other hand, have difficulty in making the distinction between the reality of the world (e.g., the chocolate is in the box) and Sally's false belief (e.g., Sally thinks that the chocolate is in the basket). They answer by saying that Sally will look in the box, that is, where the child knows the chocolate to be. This answer based on the reality shows that children do not yet understand that beliefs are just representations and can differ from the true state of the world. False belief measures have become the most common way to assess children's understanding of mental states as unobservable guides of one's own and others' behaviors.

Theory of Mind and Anthropomorphism in Infancy

Most of the research on theory of mind focuses on ages 3-5, and the findings are consistent in showing that during this period children get better at thinking about others in terms of their inner, unseen mental states. But there is also a growing body of research examining the extent that infants demonstrate some form of mental state attribution. These studies mostly focus on early attributions of intentionality. One interesting feature of these studies is that many of them make use of inanimate objects in their assessments rather than real humans (e.g., assessing the intentional behavior of a geometric shape). This strategy appears to reflect a belief that anthropomorphism is natural for infants, and in fact infants often behave in ways that are consistent with anthropomorphic interpretations.

For example, Johnson, Slaughter, and Carey (1998) claim that infants are capable of using cues in their environment to distinguish objects with minds (e.g., the ones that are worth paying attention to) and objects without minds. In these studies assessing infants' capacity to attribute mental states, gaze following behavior is often used as a sign of infants' attribution of a mind to an agent. In other words, researchers believe that infants will follow the gaze (or more generally, the orientation) of an object if they attribute a mind to it.

The stimuli used in these studies are often inanimate. For example, Johnson et al. (1998) found that 12-month-old infants followed the orientation (as they would do with a direction of a gaze) of a novel object (e.g., a blob) if the object had a face. They also found that infants followed the gaze of the novel object when it demonstrated self-propelled contingent movement (moving in response to the infant's behavior) even in the

condition in which the object did not have a face. Thus, infants use cues such as physical similarity and self-propelled contingent movement to guide their attributions of minds to objects they see around them.

Gergely and his colleagues (Csibra, Gergely, Biro, Koos, & Brockbank, 1999; Gergely, Nadasdy, Csibra, & Biro, 1995) also tested the cues that trigger the attribution of mind in infancy. According to their research, self-propelled movement and contingent action (e.g., moving in response to a factor), but not morphological similarity, are important factors for infants' attribution of mental states, such as intentionality and goal-directedness of behavior. However, they also found that infants attributed intentionality to objects even in the absence of these cues. Gergely and colleagues (1995) showed 9- and 12-month-old infants movies of simple dots in which the dots demonstrated self-propelled movement and contingent action by reacting to each other's actions (e.g., a dot expanding when the other dot expands) - which the researchers believed to be cues to trigger attribution of intentionality. When these cues were present, infants seemed to expect humanlike behaviors from them. For instance, they expected these dots to fulfill their intentions in the most direct way. If a dot had an intention of going to the other side of the stage, it should follow a direct path because it is the shortest and most rational path to the intended goal state. However, if there is an obstacle on the way to the other side of the stage, then a rational behavior could be to jump over the obstacle to reach the other side. Consistent with an anthropomorphic interpretation, infants seemed surprised if a dot chose a less rational way to reach its goal state when a rational option was available (e.g., jumping along the way instead of directly crossing the stage, when there is no obstacle).

In a follow up study, Csibra et al. (1999) found that infants do not even need those cues to attribute intentionality to an object. When the dots were stripped of the cues (e.g., it was not clear whether the dot moved in its own accord or with a push from an outside factor), infants still expected these dots to demonstrate humanlike behaviors (i.e., to behave rationally). Thus, even when the dots did not display anthropomorphic triggers, infants seemed to attribute intentions and rational thinking to them. These two studies were interpreted as demonstrating how minimal cues can trigger attribution of a humanlike mind.

In other studies looking at infants' social behaviors and expectations, anthropomorphism is not measured directly but the findings were interpreted with the assumption that infants understand the inanimate objects in humanlike terms. For example, Hamlin, Wynn, and Bloom (2007; 2010) used puppet-like geometric shapes in simple demonstrations of "helping" or "hindering" actions. In the helping scenarios, a square helped a circle to go up the hill by giving him a push from behind, and in the hindering scenario a triangle pushed the circle back down the hill. When given an option to choose from one of the shapes, infants preferred to play with the "helping" shape. They also looked surprised when the circle sat next to the hindering ("mean") triangle, instead of the helping ("nice") square. Hamlin et al. interpreted their results as suggesting that infants as young as 6-months-old seemed to understand the goals behind the actions and "assess individuals on the basis of their behavior towards others" (e.g., the helping triangle is nice, whereas the hindering triangle is mean) (Hamlin et al., 2007, p. 557). The researchers assumed that infants' evaluations of these geometric shapes were reflections of how they would evaluate other people.

Johnson, Dweck, and Chen (2007) also used movies with geometric shapes to study internal working models of attachment. They were interested in infants' expectations about parent-child interactions, and wanted to test whether 12 to 16 month old infants will react differently to different scenarios depicting mother-child separations. However, instead of using real people in their testing, the researchers showed movies of two circles- one small and one big- assuming that infants would attribute 'mother' characteristics to the big circle and 'child' characteristics to the small one. They looked at children's reactions to two different scenarios depicting separation and reunion of the two circles. In both scenarios, the big circle left the small circle alone and went away, and the small circle got upset (e.g., vibrated and made a crying sound). The difference between the scenarios in the latter part of the video was that, in one scenario, the big circle responded to the little one's distress by returning to it, and in the other, the big circle went further away despite the distress of the little one. Infants with secure attachment to their parents showed surprise (e.g., looked longer) in response to the movie in which the big circle left the small circle alone and did not return when the small circle displayed signs of distress. Johnson et al. interpreted infants' reactions to these movies as reflecting the child's attachment style with their own parents. This interpretation of the data assumes an anthropomorphic understanding of the movies. For example, in order to be surprised at the separation scenario in which the big circle does not return infants must have (at least, implicitly) understood that the circles represented a mother and a child, and would act accordingly (e.g., mothers return when children cry). Johnson et al. assumed that self-propelled action of the circles (e.g., circles moving on their own accord) would

be enough to trigger anthropomorphism in infants and that infants would understand the big circle as a mom and small circle as a child.

However, not all infant studies have found evidence for anthropomorphic thinking. In a study by Meltzoff (1995), 18-month-olds infants watched demonstrations of either human arms or mechanical pincers trying to accomplish a goal (e.g., pull apart a dumbbell) and failing in their attempt. The infants were then given an opportunity to play with the dumbbell. Meltzoff reasoned that if infants attributed intentionality to these agents, they should understand the goal of the object, even when the agent demonstrating the behavior does not reach that goal. Only infants who watched human arms trying to pull apart a dumbbell (but failing) imitated the action with the final goal state (pulling it apart). Thus, these infants appeared to understand the intentional nature of the behavior. On the other hand, infants who watched mechanical pincers doing exactly the same actions seemed not to attribute intentionality to this mechanical device. They did not imitate the end state of the intended action (dumbbell pulled apart) when given an opportunity to play with it. If infants anthropomorphize as easily as the previously mentioned studies suggested, it is surprising to find that infants in this study attributed intentionality to humans only, denying intentionality to the mechanical objects.

Similar to Meltzoff's findings, Woodward (1998) found that infants attribute goal directed behavior (which is an aspect of attribution of intentionality) to human arms but not to a rod that moved in the same ways as a human arm. In her study, infants watched a human arm reaching to one of two objects located on each side of the screen. In the habituation phase, infants watched this goal-directed reaching motion of the arm moving towards the same object in the same location, such as towards a teddy bear on the left

side of the screen, repeatedly until they lost their interest in the movie. In one test condition, the arm moved in the same direction as the habituation phase, but the end object was a different one from the habituation phase (e.g., reaching to the left side of the screen for a ball). In the other test condition, the arm moved in the opposite direction but reached for the same goal object as the habituation phase (e.g., reaching to the right side of the screen for the teddy bear). If infants attribute intentionality and goal directed behavior to humans, they should act surprised (e.g., look longer) when they see the human arm reaching for a different object than in the habituation phase. In other words, they should expect that the arm will move with the intention to reach the teddy bear and would be surprised when it goes to the ball. After all, in the habituation phase the human arm's motions made it clear that the goal was to reach for the teddy bear. Even 6-month-old infants attributed intentionality and goal directedness to the human arm. If anthropomorphism was as natural to infants as previously suggested, the results should be similar when a rod was used instead of a human arm, because they would attribute goal-directedness to the rod as they did to the human arm. This was not the case: When infants saw a rod reaching for an object in the same way as a human arm, they were not surprised to see the rod reaching for one object or the other; that is, they did not seem to attribute intentionality and goal directedness to the rod.

Infants in the Woodward (1998) and in the Meltzoff (1995) studies seemed to expect goal-directed, intentional behavior from humans, but not from nonhumans. It is difficult to interpret these results because they contradict the results showing that infants readily attribute intentions to simple geometric shapes. Perhaps the attribution of humanlike characteristics, such as intention, might be triggered in movies depicting

contingent interactions between shapes, but there are not enough such cues in the movies depicting disembodied arms/mechanical pincers acting on stable inanimate objects. In any case, it is interesting that infancy researchers routinely use inanimate objects in studies that are meant to explore the development of understanding about human intentions.

Theory of Mind and Anthropomorphism in Autism Spectrum Disorders

More evidence for a link between theory of mind and anthropomorphism comes from studies with individuals with Autism Spectrum Disorders (ASD). Individuals with ASD are usually characterized by their difficulty in social situations, which is most often explained as reflecting deficits in their theory of mind (Baron-Cohen, Leslie, & Frith, 1985). Recent studies found that these individuals also tend to not anthropomorphize.

In a study by Castelli, Frith, Happé, and Frith (2002) the researchers showed their participants three kinds of animation movies: (1) random animation sequences where two triangles did not interact; they just floated, (2) goal-directed animation sequences in which there was direct reciprocal behavior between the triangles (e.g., chasing, fighting), and (3) theory of mind (ToM) sequences in which the characters (i.e., geometric shapes) responded to each other's behavior as if they attributed mental states to the other. The participants were asked to tell the experimenter what happened in each of the movies. Individuals with ASD (M_{age} *= 33 years)* did not differ from the control groups *(*M_{age} *= 25 years)* in their descriptions of random and goal-directed animation sequences. However, they provided descriptions that were less accurate in the ToM sequences and attributed fewer mental states to objects. For example, in response to a ToM animation in which a mother was coaxing a reluctant child to go outside, the ASD group's descriptions were

less accurate (e.g., "*fighting each other*" as opposed to "*mother pushed, cuddled*"). They also used more inappropriate mental state terms in response to ToM sequences (e.g., "*child is stuck in there, mother is pushing her*" as opposed to "*mother is trying to take the little one out, little one does not want to go out*").

Klin (2000) employed Heider and Simmel's (1944) animated movie of geometric shapes to assess social cognitive abilities of individuals with ASD. She recruited 20 adolescents and adults with higher-functioning autism (HFA; M_{age} *= 20 years*), 20 participants with Asperger Syndrome (AS; M_{age} *= 18* years), and 20 typically developing participants (M_{age} *= 20 years)*. In her study, individuals with HFA and AS did not refer to the social aspects of the movie (e.g., big triangle and little triangle fighting) as much as the control group. HFA and AS groups also used fewer cognitive (e.g., belief) and affective (e.g., happy) mental state terms in their descriptions of the movies of geometric shapes.

Bowler and Thommen (2000) also attempted to examine the mentalizing abilities of children with ASD by looking at their narratives for Heider and Simmel's movie. As with the above mentioned studies, Bowler and Thommen asked their participants to describe what happened in the movie. Eleven children with ASD (M_{age} = 10 years, 7 months), 11 chronological age-matched (M_{age} = 10 years, 6 months), 11 verbal age-matched (M_{age} = 8 years, 1 month), and 11 IQ-matched children (M_{age} = 10 years) took part in this study. None of the children used many mental state terms (e.g., think, know, want). However, children with ASD overall used significantly fewer propositions describing goal-directed actions between animate objects. Thus, although these individuals used mental states almost as much as control groups, they had trouble

understanding the connection between behaviors and goals that are driving the behavior. For example, they referred to coordinated behaviors of the agents (e.g., big one is trying to hit the little one and chases after the little circle) much less frequently than the control groups. In summary, individuals with ASD, who are known to have difficulties in mental state attribution to people, show similar difficulties when asked to interpret the social interactions between geometric shapes. This result supports the hypothesis for a link between theory of mind and anthropomorphism.

Goals of the Dissertation

The literature reviewed in this chapter indicates that there are individual differences in the extent that both children and adults anthropomorphize and suggests a close relation between anthropomorphism and the theory of mind framework used for understanding human interactions. If anthropomorphism involves the extension of theory of mind, then individual differences in anthropomorphism and theory of mind should correlate. Moreover, anthropomorphism might also be correlated with social behaviors that are known to correlate with theory of mind. The goals of this dissertation were to: 1) explore the predicted links between anthropomorphism and important aspects of social understanding, and 2) to explore the development of anthropomorphism in children.

In the adult literature, individual differences in anthropomorphism were found to predict important social behaviors towards *nonhumans*. In Study 1, I investigate the relation between anthropomorphism and social behaviors such as empathy, and prosocial attitudes towards *humans*. In Study 2, I examine the link between theory of mind and anthropomorphism in preschool children – a period during which children show changes both in theory of mind and anthropomorphism. In addition, this study provides

information about the developmental trajectory of anthropomorphism from age 4 to age 6 and the relation between anthropomorphism and pretend play behavior, and social preferences.

CHAPTER II

STUDY 1: CORRELATES OF ANTHROPOMORPHISM IN ADULTS

Introduction

In most accounts, anthropomorphism is described as universal, effortless, and automatic (Guthrie, 1993; Hume 1757/1956; Piaget, 1929). However, recent research shows that there is substantial variation in the extent that adults anthropomorphize, which has been explained by differences in experience, culture, cognitive reasoning styles, and/or attachment to human and nonhuman agents (Epley et al., 2007). Thus far, the empirical evidence supports links between anthropomorphism and strong feelings of care and concern for *nonhumans* (Waytz, Cacioppo, et al., 2010). The goal of this study is to extend previous findings by investigating the extent that anthropomorphism predicts important social variables related to *human* interactions, such as feelings of concern for other people.

Measures of Anthropomorphism

Past research investigating anthropomorphism has utilized a methodology adapted from Heider and Simmel's (1944) work on social attribution. In this method, participants are shown animated movies of geometric shapes and then are asked to describe what happened in the movie. This measure reveals developmental changes in the extent that geometric shapes in the movie are anthropomorphized (e.g., adults anthropomorphize more than children; Springer et al., 1996) and also differences between typically developing individuals and individuals with Autism Spectrum Disorder (Klin, 2000). However, Heider and Simmel type movies are less useful for assessing individual differences in adults because of a ceiling effect. Studies using this method found that

adults almost invariably use humanlike mental states in their movie narratives – 97 % of adults in Heider and Simmel (1944) and 100% in Berry et al. (1992) used anthropomorphic language.

More recently, Waytz, Cacioppo, et al. (2010) constructed a self-report measure in order to assess individual differences in anthropomorphism. The Individual Differences in Adult Anthropomorphism Questionnaire (IDAQ) is a 30-item self-report measure that assesses stable individual differences in the extent that adults think of nonhumans in humanlike terms. This questionnaire has items concerning three categories of nonhumans: natural entities (e.g., wind, tree), technological devices (e.g., car, computer), and nonhuman animals (e.g., cheetah, insect). Participants are asked to rate the extent that these entities have higher order mental states (e.g., consciousness, free will, intentions, and emotional experiences) on a scale from '*not at all'* to '*very much'*. The scale was found to be reliable, and the findings showed that the IDAQ tapped individual differences in attribution of humanlike mental capacities to nonhumans.

Moreover, researchers found that individual differences on the IDAQ predicted important social behaviors, such as moral judgments, towards nonhumans. For example, participants who scored high on the IDAQ were more likely to report that it was wrong to destroy IBM's famous chess playing computer (Waytz, Cacioppo, et al., 2010). In addition, participants' IDAQ scores predicted the attribution of unique human emotions (e.g., hope, shame) to nonhuman animals, environmental concern (e.g., being concerned about the protection of trees and plants), and responsibility and trust attributed to a nonhuman agent (e.g., participants who anthropomorphized more had higher trust in a robot's prediction about a heart attack risk).

The goal of this study was to further investigate the correlates of anthropomorphism in typically developing adults. In this study, I investigated the relation between scores on the IDAQ and social behaviors that are important in interactions with other people – social understanding, empathy, and prosocial behavior.

Anthropomorphism and Social Understanding

The attribution of mental states to others is key to success in human social interactions. Waytz, Cacioppo, et al. (2010) showed that individual differences on the IDAQ predicted social behaviors towards *nonhuman* agents (e.g., attributing shame to a cat, finding the abandonment of rare flowers wrong). It is possible that individuals who anthropomorphize more are also more likely to attend to the mental states of others and have better social skills. This prediction of a possible link between anthropomorphism and social understanding is consistent with evidence from neuro-imaging studies. The same brain regions (e.g., medial prefrontal cortex) that are activated when participants are engaging in a mental state attribution task involving people (e.g., answering questions about a story character's beliefs) are activated when participants are asked to watch Heider and Simmel type animations of geometric shapes in which shapes are the target of mental state attribution (Castelli et al., 2002; Waytz, Morewedge, et al., 2010).

Another line of evidence for a possible link between social understanding and anthropomorphism comes from research on Autism Spectrum Disorders (ASD). Individuals with ASD who show difficulties in mental state attributions and empathy (Baron-Cohen, 1995) do not anthropomorphize as much as typically developing individuals (Abell, Happe´, & Frith, 2000). For example, when they were asked to describe Heider and Simmel type animations, interpretations of individuals with ASD

differed dramatically from those of typically developing individuals: individuals with ASD focused on actual physical actions of the shapes, whereas typically developing individuals inferred mental states from the actions of the shapes**.**

Previous studies utilized samples of individuals with a clinical diagnosis of ASD and asked these individuals to narrate animated movies of geometric shapes. In this study, I am administering the Autism-Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) to assess traits associated with the autistic spectrum in a typically developing college sample, and I am measuring anthropomorphism on a self-report measure. Based on the findings of past studies, I expected that lower scores on the IDAQ would predict higher levels of autistic traits as measured by the AQ.

Anthropomorphism, Empathy, and Prosocialness

Waytz, Cacioppo, et al. (2010) found that anthropomorphism was correlated with the attribution of uniquely human emotions (e.g., shame, guilt) to nonhumans. They also found that anthropomorphism was related to moral judgments about nonhuman animals and inanimate objects. Taken together, these findings show that individuals who score higher on anthropomorphism are likely to have strong feelings of care and concern for *nonhumans*. In this study, I examine the extent that anthropomorphism predicts feelings of care and concern for *humans*. Specifically, I predict that scores on anthropomorphism will be related to individuals' self-reported empathy levels (e.g., attribution of emotion to others and emotional reaction to others' feelings) and prosocial behaviors (e.g., helping, sharing) assessed on a self-report measure.

Anthropomorphism and Imagination

Another goal of the current study is to investigate the relationship between imagination and anthropomorphism. Imaginary companions are invented characters that are talked about or interacted with on a regular basis. The creation of an imaginary companion involves the attribution of humanlike characteristics to an inanimate object (e.g., stuffed animals) or to an invented invisible character and interacting with an imaginary companion can be considered an example of spontaneously occurring early anthropomorphism. I administered an adult imaginary companion questionnaire (Taylor, Hodges, & Kohanyi, 2002) to examine whether having a current or past imaginary companion was related to anthropomorphism – that is, whether attribution of humanlike characteristics to inanimate objects extends beyond one's own imaginary companions to other objects in the world.

In summary, this study examines the relation between adults' tendency to anthropomorphize, as measured by the IDAQ, and their self-reported autistic traits, empathy, pro-social behaviors, and history of imaginary companions. I hypothesized that anthropomorphism will be related to higher scores on prosocialness and empathy, and lower scores on the autism questionnaire. I also expected adults who have a history of imaginary companions to score higher on anthropomorphism.

Method

Participants

Nine hundred and sixty two undergraduate students completed an online study in exchange for course credit. All the participants were enrolled in undergraduate psychology courses at the University of Oregon. In pilot studies, the average time it took

participants to complete this online survey was about 15-20 minutes. The Qualtrics software that was used to collect the data kept track of the time it took participants to complete the study. As a proxy of compliance with research guidelines, this duration was examined. There was no control over participants' taking breaks and some people took hours to complete the survey, but I assumed that participants who took less than 10 minutes to complete the survey did not provide meaningful responses. Forty-three participants (4%) who took less than 10 minutes to complete the online survey were removed from the analysis.

The remaining sample consisted of 919 participants (681 females, 237 males, 1 declined to identify sex) with a mean age of 19.81 years (*SD* = 3.06; range 17-52 years). Seventy-five percent of the sample was White/Caucasian, 12 % Asian, 2 % African American, 1.5 % Native Hawaiian or other Pacific Islander, 1 % American Indian or Alaska Native, and 7 % other ethnicities. Twelve participants declined to answer the question about ethnicity.

Materials and Procedure

The participants completed a one-session online survey in exchange for course credit. The survey consisted of multiple individual differences measures in the following order: *Prosocialness Scale for Adults* (Caprara, Steca, Zelli, & Capanna, 2005), *Interpersonal Reactivity Index* (Davis, 1983), *Autism Spectrum Quotient* (Baron-Cohen et al., 2001), *Individual Differences in Anthropomorphism Questionnaire* (Waytz, Cacioppo, et al., 2010), and *Imaginary Companions Questionnaire* (Taylor et al., 2002). Each of these measures will be discussed in turn (see Appendices A through E for complete list of items in each measure).

Prosocialness Scale for Adults (Caprara et al., 2005). The 16 item self-report Prosocialness Scale for Adults (PSA) was administered to assess individual differences in adult prosocial tendencies. The scale assesses four aspects of prosocial behaviors: sharing, helping, taking care of others, and feeling empathic with others and their needs or requests. For each statement (e.g., *I try to help others*) participants were asked to indicate the extent that the statement was true about themselves on a 5-point Likert scale, ranging from '*1- never/almost never true'* to '*5- almost always/always true'*. An aggregate score of prosocialness was created by averaging participants' responses over the 16 items. The mean scores ranged from 1.38 to 5, with higher scores indicating more prosocialness (M = 3.68, SD = .59). The scale showed high internal consistency; α = .91.

Interpersonal Reactivity Index (Davis, 1983). The Interpersonal Reactivity Index (IRI; Davis, 1983) is a 28-item measure tapping four facets of empathy: perspective taking (M = 3.44, SD = .61), empathic concern (M = 3.76, SD = .57), personal distress (M = 2.88, SD = .62), and fantasy (M = 3.50, SD = .69). Each subscale had 7 items, and participants were asked to rate the extent that each item described them on a 5-point Likert scale, ranging from '*1- does not describe me at all'* to *'5-describes me very well'*. Nine of the items were reverse scored (e.g., *I sometimes find it difficult to see things from the "other guy's" point of view).* Higher scores on the subscales indicated higher empathy. All four subscales showed good internal consistencies, αs > .78.

Autism Spectrum Quotient (Baron-Cohen et al., 2001). The Autism Spectrum Quotient, AQ, is a 50-item measure assessing five different aspects of autism spectrum: social skill (M = 1.91, SD = .46), attention switching (M = 2.45, SD = .36), attention to detail (M = 2.53, SD = .45), communication (M = 1.92, SD = .41), and imagination (M =

1.93, *SD* = .37). Participants were asked to rate the extent they agreed with each item (e.g., *I find social situations easy)* on a 4-point Likert scale: '*1- definitely agree', '2- slightly agree', '3- slightly disagree',* and '*4- definitely disagree'*. Overall, higher scores indicated higher number of autistic traits. Approximately half of the questions were reverse-coded (e.g., *When I talk on the phone, I'm not sure when it's my turn to speak*). Due to a large number of missing data in our sample, instead of adding the item ratings, scores on the 50 items were averaged to get an aggregate score for the full AQ. Aggregate scores ranged from 1.42 to 3.32, and the mean was 2.15 (*SD* = .25). Internal consistency for the full scale was good, α =.79. However, subscale reliabilities were low and ranged from .53 (imagination subscale) to .78 (social skills). The subscales generally correlated positively with each other (*r*s ranging from .08 to .67, *p*s < .05), except that the attention to detail subscale did not correlate with the social skills, attention switching, and imagination subscales. I did not have specific hypotheses in relation to subscales, thus, for the rest of the paper, I will focus on the full scale AQ scores.

Individual Differences in Anthropomorphism Questionnaire (Waytz, Cacioppo, et al., 2010). The IDAQ is a 30-item questionnaire designed to assess individual differences in adults' anthropomorphism. The items tapped anthropomorphism of natural entities, animals, and technological devices. The questionnaire includes 15 anthropomorphism items (e.g., "*To what extent does the average fish have free will?*") and 15 non-anthropomorphism items that served as control items (e.g., "*To what extent is the average cloud good-looking?*"). Participants were asked to indicate their responses on a 0 (*not at all*) to 10 (*very much*) scale.

In an exploratory factor analysis, Waytz, Cacioppo, et al. (2010) found that a two-factor model provided good fit to their IDAQ data in which anthropomorphism of animal items loaded on one factor and anthropomorphism of nonanimal items loaded on the second factor, with nonanthropomorphism items loading diffusely on both factors. They then ran a confirmatory factor analysis on the 30 items and found the same pattern. A secondary confirmatory analysis further revealed that a model with a superordinate general anthropomorphism factor provided a good fit, suggesting that anthropomorphism could be a general tendency.

When I ran a factor analysis on the 30-item full scale IDAQ, contrary to Waytz et al.'s results, an eight-factor emerged with no clear pattern. Since my interest is specifically in anthropomorphism items, I then ran a factor analysis on the15 items that tap anthropomorphism. This factor analysis revealed a two-factor solution, explaining 50.85 % of the variance. Similar to Waytz et al.'s findings, items concerning anthropomorphism of nonanimals (i.e., natural entities and technological devices) loaded on the first factor, explaining 34.35 % of the variance, and items concerning anthropomorphism of animals loaded on the second factor, explaining 16.50 % of the variance.

The mean scores for the full anthropomorphism scale (all 15 items) ranged from .20 to 9.33, and the mean was 3.86 (SD = 1.60), with higher scores indicating greater tendency to anthropomorphize. The mean for anthropomorphism of animals was higher (M = 6.07, SD = 1.86) than the mean for nonanimal items (M = 2.76, SD = 1.98), t (917) = 43.32, $p < .01$. Internal consistency for the full anthropomorphism scale (α = .85) as well as for the animal items subscale (α = .78) and the nonanimal items subscale (α =

.87) were good. These two subscales were significantly correlated with each other, r (916) = .27, $p < .01$.

The mean scores for the non-anthropomorphism scale (15 items) ranged from 1.22 to 9.33 (M = 6.02, SD = 1.03). The items in this scale were not written in a systematic way to assess an underlying construct but as a way to control for individuals' scale use. Despite this, the internal consistency for the non-anthropomorphism scale was acceptable (α = .69). Anthropomorphism and non-anthropomorphism scales of the IDAQ were highly correlated, r (917) = .50, $p < .001$, suggesting that individuals might have differed in the way they used the response scale regardless of the item type (anthropomorphism vs. non-anthropomorphism items) and that this factor should be controlled by adding non-anthropomorphism scores in the analyses as covariates.

Imaginary Companion Questionnaire (Taylor et al., 2002). For the last phase of data collection, we added the adult imaginary companion questionnaire to our battery of measures. Two hundred and sixty four students (69 males, 195 females; *Mage* = 19.18, *SD* = 1.71, *range* = 18-34) participated in this part of the survey. They first read a description of imaginary companions: "An imaginary companion is someone who is make-believe; an imaginary person or animal that you talk to or think about a lot. Sometimes an imaginary companion is completely invisible and sometimes it is a toy, like a very special stuffed animal or doll."

Then they were asked whether they currently had an imaginary companion "*Do you currently have an imaginary companion?"* After this question, came a question about the kind of the imaginary companion "*If yes, is it invisible or is it an object?"* If participants stated that it was an object, they were asked "*If object, how is this stuffed*

animal, doll, or object different from other stuffed animals, dolls, or objects?" Finally, they were asked to describe their imaginary companion.

After these questions about current imaginary companions, participants were asked about childhood imaginary companions "*What about when you were younger, when you were a child? Did you have an imaginary companion then*?" This question was followed with the same questions about the kind of the imaginary companion, and how it was different from others (if the participant stated that it was an object), and finally participants were asked for a description of the imaginary companion.

Participants were coded as having an imaginary companion based on their answers to the question directly asking about the presence and the kind of an imaginary companion (invisible friend vs. personified object) in the past and present. Based on their reports, nine participants were coded as having a current imaginary companion (2 invisible friends, 5 personified objects, and 2 non-specified) and 68 participants reported having had an imaginary companion as a child (37 invisible friends, 27 personified objects, and 4 non-specified). Six people who reported having an imaginary companion currently also reported having had one as a child.

Results

Table 1 shows the correlations among measures of autistic traits, empathy, prosocialness, and the IDAQ. I expected a positive correlation between empathy and prosocialness, and negative correlations between autistic traits (as measured by the AQ), empathy (as measured by the IRI), and prosocialness. As expected, the prosocialness scale correlated positively with all subscales of the IRI (rs (916) > .25, ps < .01) except for the personal distress subscale. Prosocialness scale scores also correlated negatively

with the full scale AQ, r (916) = -.38, $p < .01$. Consistent with my predictions, the IRI subscales correlated negatively with the full scale AQ, rs (916) > -.14, $ps < .01$, except for the personal distress subscale of the IRI which correlated positively with the AQ, r (917) = .23, $p < .01$.

I did not have specific hypotheses in relation to gender, but based on previous literature, I expected females to have higher scores on empathy and prosocialness scales (Belansky & Boggiano, 1994; Klein & Hodges, 2001). I also expected males to show more autistic traits (Baron-Cohen, 2002). In line with these expectations, I found that females scored higher on all subscales of empathy and prosocialness, ts (915) > 2.22, $ps < .05$. Females also scored lower on the AQ (M = 2.13, SD = .24), than males (M = 2.18, SD = .25), t (916) = 2.69, $p < .01$. Correlations between the IRI subscales, prosocialness, and full scale AQ did not change after controlling for gender.

I then looked at correlations between anthropomorphism, as measured by the IDAQ, and measures of autistic traits, empathy, and prosocialness. When data with large sample sizes are analyzed, it is possible to get statistically significant correlations (i.e., $p < .05$) with small effect sizes. Since there were 21 pairwise correlations to test, I used a Bonferonni correction, and set the significance value at .002. Even then, there were some statistically significant correlations between my test variables (See Table 1). When a regression model was run, predicting the IDAQ scores from these social variables, autistic traits, the personal distress subscale of the IRI, and prosocialness held up as significant predictors of the IDAQ scores. However, given the sample size (n = 919), considering effect size as a way to interpret data might be more meaningful than looking at statistical significance.

Table 1. *Correlations between measures of anthropomorphism, empathy, autism, and prosocialness*

	IDAQ total	IDAQ animals	IDAQ nonanimals	IRI-fantasy	IRI-PT	IRI-EC	IRI-PD	AQ
IDAQ animals	-							
IDAQ nonanimals	-	**.27****						
IRI-fantasy	.04	.10**	.00					
IRI-PT	.02	.02	.02	**.26****				
IRI-EC	.05	**.11****	.00	**.38****	**.44****			
IRI-PD	**.11****	.04	**.11****	**.12****	-.07*	**.18****		
AQ	.08*	-.06	**.13****	**-.14****	**-.22****	**-.29****	**.23****	
PSA	.09**	**.13****	.06	**.26****	**.47****	**.64****	-.01	**-.38****

Note. IDAQ= Individual Differences in Anthropomorphism Questionnaire; IRI = Interpersonal Reactivity Index; IRI-PT= IRI-Perspective Taking; IRI-EC= IRI-Empathic Concern; IRI-PD = IRI-Personal Distress; AQ = Autism Spectrum Quotient; PSA = Prosocialness Scale for Adults. *N*s range from 917 to 919. *$p < .05$, **$p < .01$. Correlations that are in bold are significant after Bonferonni correction (< .002).

None of my predicted correlations between the IDAQ scores and measures of social behaviors had effect sizes that are meaningful (*r*s < .12, explaining less than 1.4 % of the variance). Thus, overall, the data did not support the prediction of strong relationships between anthropomorphism, and autistic traits, empathy, and prosocialness.

Next we examined individuals' creation of imaginary companions. Two hundred sixty four participants answered the questions about imaginary companions. There was no difference on any of the measures between people who reported a current imaginary companion but not a past one (*n* =3), those who reported having an imaginary companion only when they were a child (*n* = 62), and those who had an imaginary companion as a child and still had one (*n* = 6). Thus, we collapsed these three groups. One hundred and eighty eight participants reported that they had never had an imaginary companion, and 71 (59 females, 12 males) reported having had one (29 said they have had a personified object, 38 have had an invisible friend, and four participants did not specify the kind of their friend; see Table 2).

Having an imaginary companion was related to anthropomorphism. Participants who had imaginary companions scored higher on the IDAQ (*M* = 4.07, *SD* = 1.63) than participants who did not (*M* = 3.64, *SD* = 1.50), *t* (257) = 2.02, *p* < .05, *d* = .27. Individuals with imaginary companions scored higher on the animal items subscale of the IDAQ (*M* = 6.34, *SD* = 1.85) than those without an imaginary companion (*M* = 5.84, *SD* = 1.85), *t* (257) = 1.94, *p* = .053. However, they did not differ on the nonanimal items subscale of the IDAQ; individuals with imaginary companions had a mean score of 2.93 (*SD* = 1.95) and those without an imaginary companion had a mean score of 2.53 (*SD* = 1.82).

Table 2. *Imaginary companion status by gender of the participant*

	Men	Women	Total
No Imaginary Companion	54 (81.8 % of men)	134 (69.4 % of women)	188 (72.6 % of total)
Invisible Friend	7 (10.6 % of men)	31 (16.1 %)	38 (14.7 % of total)
Personified Object	4 (6.1 % of men)	25 (12.0 %)	29 (11.2 % of total)
Non-specified	1 (1.5 % of men)	3 (1.5 %)	4 (1.5 % total)
Total	66	193	259

Females scored higher on the IDAQ (M = 3.95, SD = 1.58) than males (M = 3.61, SD = 1.66), t (916) = 2.80, $p < .01$, d =. 21. Thus, I controlled for gender. These results did not change substantially when gender and non-IDAQ control items (e.g., items asking about non-anthropomorphic properties of entities) were entered into equation as covariates. Individuals with a history of imaginary companions scored higher on the IDAQ, F (1, 255) = 3.43, p = .065 and on the animal items subscale, F (1, 255) = 3.63, p = .058.

As would be predicted, individuals with a history of imaginary companions also scored higher on fantasy subscale of the IRI (M = 3.71, SD = .68) than participants who have not had imaginary companions (M = 3.46, SD = .67), t (256) = 2.66, $p < .01$, d = .37. Participants with a history of imaginary companions also scored lower on the AQ (M = 2.08, SD = .23) than those without a history of imaginary companions (M = 2.16, SD = .24), t (257) = 2.46, $p < .01$, d = .34. These differences between the groups were meaningful as the effect sizes demonstrate, and they held after controlling for gender, F

(1, 255) = 5.74, p = .017 and F (1, 256) = 5.27, p = .02, for the fantasy subscale of the IRI and AQ respectively. Having a history of imaginary companion was not related to other subscales of the IRI, or prosocialness.

There were unequal number of females and males in the group with imaginary companions (83 % of participants with imaginary companions were females, see Table 2). In addition, when gender and having an imaginary companion were entered into regression, gender was a significant predictor of the IDAQ scores, t = 2.06, p = .04. Having an imaginary companion was also a marginally significant predictor of the IDAQ scores, t = 1.77, p = .08.

When the type of imaginary companion was examined, we found the same pattern for invisible friends (n = 38), personified objects (n = 29), and not specified imaginary friends (n = 4). We also looked at details in participants' descriptions of their friends. Again, no difference was found between participants who did not describe their friends (n = 13), participants who described their friends in physical terms only (e.g., "she had blonde hair"; n = 39), and participants who went beyond physical properties in their descriptions (e.g., "she was friendly"; n = 19).

Discussion

The IDAQ is a self-report measure of anthropomorphism that yielded individual differences in a previous study (Waytz, Cacioppo, et al., 2010). In the current study, I found substantial individual differences as well and found a two-factor solution of 15 anthropomorphism items: animal items loading on one factor and nonanimal items (natural entities and technological devices) loading on the other factor, with the two factors correlating significantly.

One goal of this study was to investigate the relation between anthropomorphism and socially relevant variables. Based on previous research showing that high anthropomorphism predicts emotion attribution to nonhumans and moral judgments related to nonhumans, I expected anthropomorphism to also predict self-reported empathy and prosocial behavioral tendencies in human social interactions. I found some significant correlations between anthropomorphism, self-reported prosocialness and empathy; however, these had very small effect sizes.

I also predicted that people who score higher on anthropomorphism would have higher social understanding (e.g., attribute mental states more readily to humans) and thus score lower on autistic traits, but I did not find predicted correlations between anthropomorphism and social understanding as measured by autistic traits. These null results might be due to the differences in samples used in the previous studies and the current one. Previous studies measuring the link between autism and anthropomorphism used samples of individuals with a clinical diagnosis of Autism Spectrum Disorder (ASD). In contrast, my sample consisted of college students. I did not expect to have clinical levels of autism; yet, I expected to find variability in autism scores in this sample. However, in this sample the mean for the autism scale was low and it showed little variability.

Null findings between anthropomorphism and social understanding (as measured by the AQ) could also possibly be explained by measurement issues. Previous studies using samples of individuals with autism used a movie narrative measure of anthropomorphism (Klin, 2000; Castelli et al., 2002) and found that participants with

autism anthropomorphized less than typically developing individuals when asked to describe what happens in a Heider and Simmel type animated movie of geometric shapes. This relation was not evident with the self-report measure of anthropomorphism used in this study. In the future, it will be interesting to look at how these two different measures of anthropomorphism are related to each other and whether they are tapping the same underlying construct.

The null findings also might suggest that the extent individuals anthropomorphize might be influenced more by other factors (e.g., cognitive reasoning styles, personal preferences) than by mental states attributions in human social interactions. It is possible that being able to take the perspectives of others is necessary for anthropomorphism, but not sufficient in predicting individual differences in anthropomorphism. Once you have a certain capacity to understand people as guided by mental states, then situational and dispositional factors might be more influential in predicting whether you will extend the framework to nonhumans.

This explanation is consistent with my finding that individuals who had a history of imaginary companions scored higher on anthropomorphism than individuals without an imaginary companion. The developmental literature on children's imaginary companions suggests that creation of an imaginary companion (which is an early example of spontaneous anthropomorphism) is connected with personality variables (e.g., lack of shyness; Taylor, Sachet, Maring, & Mannering, 2012). It is possible that some people are more motivated to create humans out of nonhumans than others, which might explain their tendencies to create imaginary companions and to anthropomorphize.

The weak findings in relation to social understanding also urge us to look at this relationship in a younger sample when these skills are developing. The preschool period is a time when striking advances occur in children's social mental state attributions. In a sample with more variability in mental state attribution abilities, it might be possible to find the predicted link between social understanding and anthropomorphism.

The preschool period is also a time when many children create imaginary companions. We found interesting links in adult retrospective data between having a history of an imaginary companion and anthropomorphism. However, only 27 % of participants reported a current or past imaginary companion. Previous studies in the preschool period found that about 66% of children had imaginary companions (Taylor, 1999); therefore I examined the relation between having imaginary companions and anthropomorphism with a sample of preschool children.

CHAPTER III

STUDY 2: DEVELOPMENT AND CORRELATES OF ANTHROPOMORPHISM IN PRESCHOOL CHILDREN

Introduction

The preschool period is a time during which children show advances in their understanding that people's behaviors are guided by their beliefs, desires, and intentions (Wellman, 1990). This framework of social understanding, referred to as theory of mind (ToM), has been investigated extensively in children between the ages of 3 and 5 (Wellman & Liu, 2004). However, the relationship between ToM development and the extension of this framework to nonhumans (i.e., anthropomorphism) has not been systematically studied in this age group. The goal of this study was to investigate the development and correlates of anthropomorphism in 4-, 5-, and 6-year-old children with two new measures that were adapted from past research.

One way of assessing the extent that children anthropomorphize is to ask them if they think that various nonhuman agents have independent agency (e.g., have a mind of their own). Piaget (1929) used this method focusing on two mental states: knowing and feeling (e.g., "*Can clouds feel the wind?*"). Based on his interview results, he concluded that there is a developmental trend for younger children to attribute knowing and feeling to a wider range of nonhumans than older children. This method of asking participants explicitly about the way they think about nonhumans has also been used with adults (e.g., "*To what extent does the average fish have free will?*"; Waytz, Cacioppo, et al., 2010). Contrary to Piaget's claims, Waytz and colleagues found that some adults attributed humanlike mental states to nonhuman animals and inanimate objects. In fact, there were

substantial individual differences in the extent they believed each object had a mind of its own, intentions, consciousness, free will, and emotional experiences.

Another way of measuring anthropomorphism is to ask children to describe the behaviors of inanimate objects. This methodology was inspired by Heider and Simmel's (1944) movie of geometric shapes moving in ways that could be described in humanlike terms. Most adults attributed personality characteristics as well as intentions, beliefs, and desires to the shapes. Studies with preschoolers, however, showed that there are individual differences in the extent that children anthropomorphize the events portrayed in the movie. Berry and Springer (1993) found that only 56% of the children described what happened in Heider and Simmel's movie in anthropomorphic terms. There were also age related changes in anthropomorphism during the preschool years. Springer et al. (1996) found that 5-year-olds and adults anthropomorphized more than younger children when asked to narrate this movie. Thus, contrary to Piaget's claims, the findings obtained with this measure showed that there are individual differences in the extent that preschool children anthropomorphize and that older children and adults anthropomorphize more than younger children.

To summarize, in both the adult and child literatures, these two different methods revealed different results. When adults were asked to narrate the events portrayed in a movie of geometric shapes, the majority used anthropomorphic terms, but when they were asked if nonhuman entities (e.g., cars, wind) had humanlike characteristics they showed substantial individual differences in the extent they thought these entities had minds of their own. Similarly, these two methodologies yielded different developmental patterns. Studies using the narrative measure found a developmental increase in

anthropomorphism, whereas interviews suggested that children grow out of their anthropomorphic tendencies as they get older.

Goals of the Study

In my dissertation I combined and extended the previously used methodologies (i.e., interview and narrative measures) to examine developmental change in children's anthropomorphism during the preschool period and the relation of individual differences in these measures to other social-cognitive aspects of development, such as theory of mind. To my knowledge, no study has used both methods with the same group of children. By using both methodologies in the same study, I hoped to learn more about the underlying constructs tapped by each measure and the relation between them.

Measures of Anthropomorphism

Narrative measure. In the anthropomorphism measure inspired by Heider and Simmel (1944), I asked children to narrate short movies in which the moves of basic geometric shapes were contingent upon the others and could be interpreted in humanlike terms. However, I created two new movies to extend the range of interpersonal interactions to include exclusion, friendship, and helping, in addition to bullying (which was depicted in Heider and Simmel's movie). Thus, the study consisted of a wider range of stimuli than past research and included both negative and positive interpersonal behaviors (e.g., excluding someone from a game vs. making friends).

Interview measure. My goal was to create a new interview measure of anthropomorphism that could be easily administered to preschool children. I adapted a method that is used with young children in clinical psychology (Berkeley Puppet Interview; Measelle, Ablow, Cowan, & Cowan, 1998) and included content that was

inspired by Piaget's interviews and research with adults (Waytz, Cacioppo, et al., 2010). The items included content that reflected a wide range of mental states (e.g., thinking, perception, emotion, knowledge, and personality traits).

Development of Anthropomorphism. I used the narrative and the interview measures to assess developmental changes in anthropomorphism. I hypothesized that older preschool children would be more likely to use anthropomorphic language in the narratives for movies of geometric shapes than younger preschoolers, replicating past results (Springer et al., 1996). I also examined age differences in the puppet interview measure (i.e., the extent of agreement with anthropomorphic statements). Piaget (1929) found that when interviewed, younger children are more likely to attribute humanlike characteristics (i.e., knowing and feeling) to nonhumans than older children and adults. However, since Piaget, the interview technique has not been used with preschoolers to investigate anthropomorphism and studies using other measures (e.g., narrative measure) have demonstrated a different developmental pattern. Thus, I did an exploratory analysis of children's response patterns on the interview measure to examine age related changes.

Correlates of Anthropomorphism

Theory of Mind. Several lines of research allude to a relationship between theory of mind (ToM) and anthropomorphism. As reviewed in Chapter 1, researchers studying ToM in infancy make assumptions about infants' use of anthropomorphism (Gergely et al., 1995) and interpret infants' reactions to the movies that depict geometric shapes as reflecting their social understanding. In addition, individuals with Autism Spectrum Disorder (ASD), who have difficulty in ToM tasks, also anthropomorphize less when assessed on a narrative measure (Klin, 2000). Moreover, neural correlates of ToM and

anthropomorphism are found to be similar (Castelli, Happe, Frith, & Frith, 2000). However, the relationship between ToM and anthropomorphism has not been systematically investigated. Based on previous literature, I expected children who scored higher on anthropomorphism measures to perform better on ToM tasks.

Imaginary companions. There is ample evidence that children can anthropomorphize nonhumans during the preschool years. They attribute humanlike characteristics, such as personalities and mental states to their dolls and stuffed animals. Moreover, some of them go on to create imaginary companions – characters that are talked to or interacted with on a regular basis. While some imaginary companions are based on personified objects (e.g., a stuffed animal), real people (e.g., a pretend version of the child's best friend), or media characters (e.g., the Little Mermaid), many are unique invisible characters (e.g., a tiny tie-dyed veterinarian named Elfie Welfie).

It is possible that children who create imaginary companions also extend their anthropomorphism beyond their own imaginary companions to other nonhumans in the world. However, this is the first study to test the relationship between having an imaginary companion and anthropomorphism in this age group. The results of Study 1 showed that adults with a history of imaginary companions scored higher on an interview measure of anthropomorphism. Based on these results, I expected preschool children with imaginary companions to score higher on anthropomorphism.

Social Preferences. In adults, loneliness (either dispositional or experimentally manipulated) was found to predict adults' tendency to anthropomorphize (Epley, Akalis, et al., 2008). Researchers explained this tendency as reflecting the motivation to establish social connections with another agent (i.e., sociality motivation). Although

loneliness has been used to test the sociality motivation in adults, another way of testing it could be to assess the extent of people's motivation to be social. It might be the case that people who are interested in social relations and highly motivated to socialize with others (regardless of feelings of loneliness) would anthropomorphize more than others.

In this study, I asked parents to rate their children's social interests (i.e., motivation to engage in social interaction) and their "conflicted shyness" (i.e., child's fear and anxiety in social situations despite a desire to be social; Coplan, Prakash, O'Neill, & Armer, 2004, p. 244). Based on the sociality motivation hypothesis, I predicted that children who are rated by their parents as having high social interest (the ones who have strong motivation to be social) would anthropomorphize more. In addition, previous research has found that children who create imaginary companions are less shy than those who do not have imaginary companions (Taylor et al., 2012). Given the hypothesized relationship between imaginary companions and anthropomorphism, it is possible to expect that children who are less shy will also anthropomorphize more. However, I expected the social interest variable to be a better predictor of anthropomorphism than shyness, because it is conceptualized as a pure measure of children's motivation to be social as opposed to shyness variable measuring inhibition in social situations along with a desire to be social in social situations.

Control Measures. I used two control measures in order to assess children's capacity to make attributions of agency, mental states, and personality when asked to describe something other than geometric shapes. I wanted to determine if children are at all capable of making mental state attributions in a laboratory setting. Thus, I utilized measures that would trigger the use of mental states and tested 1) the extent children use

mental state language when prompted with a movie that is rich in cues, 2) whether children's mental state language in the control measures related to their attributions of mental states in the narrative and interview measures of anthropomorphism.

The first control measure utilized a narrative method, just like the geometric shape movies. I wanted to test children's mental state attributions when narrating a movie of animated entities. The control movie should (1) depict similar interpersonal behaviors as the geometric shape movies, and (2) have a story that is easily understood without sound. Ideally, a silent movie of real people would be used as a control measure to assess children's general capacity to make mental state attributions when they are watching a movie of people. However, it was challenging to find a movie of real people that fulfilled these criteria. Thus, I included a control movie of animals – a short clip from the cartoon *Tweety and Sylvester*. This clip was chosen to match the theme of the geometric shape movies (e.g., chasing, fighting) and it conveyed a story without the sound. There were also many agency cues in the movie to prompt children's mental state language use (e.g., facial expressions, humanlike actions).

In addition to a movie narrative, I also included a task in which children were asked to talk about their best friends (Meins, Fernyhough, Johnson, & Lidstone, 2006). I examined how much mental state and personality terms children used in their descriptions of a real person who is well known to the child.

Due to the verbal nature of the anthropomorphism tasks, I wanted to control for verbal skills. I measured children's language capacity by the number of propositions (*verb + its complement*) they used for the narrative measure of anthropomorphism movies and the narrative measure of the control movie.

Method

Participants

The participants were 74 4-, 5-, and 6-year-old children and their parents; one child was dropped because of non-compliance, resulting in a final sample of 73 children (36 girls, 37 boys; M_{age} = 5 years, 5 months, *SD* = 9 months; *range* = 4 years, 2 months to 6 years, 8 months). The sample was predominantly white (91 %) and middle class (76 % had income more than $ 40,000 a year). These subjects were recruited from the Psychology Department's Developmental Database and were compensated $10 for their participation.

Materials

Children participated in tasks that assess individual differences in anthropomorphism, theory of mind, mental state language use, and role play. Parents completed questionnaires regarding basic demographic information, their children's social preferences, children's social understanding, and role play.

Child Measures

Assessment of Anthropomorphism. There were two measures of anthropomorphism: the narrative method and the interview method.

*1. **Narrative Method***

I created three short movies to measure children's anthropomorphic tendencies in their narratives. The movies were designed using the software I-Movie for Macs. Each short movie was viewed once from beginning to end, and then for a second viewing, short segments (15-20 seconds) of the movie were shown to the child. After each

segment, children were asked "*Can you tell me what happened there?"* The segmentation was used in order to reduce working memory load.

After all segments were viewed, a still frame of all characters of the movie was displayed on the screen and children were asked forced-choice questions: "*Do you think any of them were mean? Scared? Helpful? Friends*?" and "*Which one do you want to be friends with*?" They were given the option of verbally stating their answer or pointing to the shape(s). As a follow up, they were asked to explain their answers (e.g., "*Why do you want to be friends with the circle?*").

a) "Exclusion and friendship". In this movie there are four characters: a yellow square, an orange triangle, a green pentagon, and a pink circle. An anthropomorphic interpretation of the movie would be as follows: the square and triangle are playing happily. Then the pentagon comes over and tries to join in their game several times, but the square and triangle exclude him/her entirely. The persistence of the pentagon annoys the square and triangle and the triangle leaves the scene. The square gets mad at the pentagon and leaves the scene after pushing him/her. The pentagon gets upset. The circle then enters the scene, approaches the pentagon, jumps on top of him/her and kisses him/her expressing his/her desire to play. The pentagon gets excited, but hesitates when the circle asks him/her to come along when s/he leaves. The circle persuades the pentagon, and they go away together.

b) "Bullying" (adapted from Heider and Simmel, 1944). The characters are a big red triangle, a small green triangle, and a small blue circle. There is a rectangle with a small opening (like room with a door) located stationary on the left side of

the screen. An anthropomorphic interpretation of the movie would be as follows: the big triangle is in the room. The small triangle and the circle enter the screen together, circle each other and appear to be friends. The big triangle then leaves the room, and moves towards the small triangle. The big triangle chases and pushes the small triangle. The circle gets scared of the fight between the two characters and hides in the room. The big triangle moves into the room and chases the circle. In order to help the circle, the small triangle opens the door of the room, and the circle runs outside of the room. The small triangle and the circle close the door, leaving the big triangle inside, and they circle each other happily. The big triangle tries to open the door of the room. Although it has trouble opening it initially, s/he finally opens the door and gets out. The big triangle then chases the small triangle and circle. The small triangle and the circle manage to run away before the big triangle catches them. The big triangle gets angry and breaks the walls of the room.

c) "Helping". The three characters in this movie are a blue circle, a green square, and a yellow star. An anthropomorphic interpretation of the movie would be as follows: the circle carries a star on top, but then s/he loses balance and drops the star. The star runs away. The circle looks around for the star but cannot find it and gets upset. The square comes in with the star, and helps the star to get back up to the top of the circle. The circle gets really excited and happy to be reunited with the star. The circle gives the square a kiss, and they all leave the scene together.

Cartoon Control: "Tweety and Sylvester". In order to assess children's capacity to attribute agency and use of mental state terms for animated entities, a short clip from the cartoon "*Tweety and Sylvester*" was shown. To be more like the geometric shapes movies, there was no sound. The cartoon had many visual cues for agency attribution (e.g., faces, humanlike movements). Similar to the previous movies, the child watched the full movie once and then saw the segments. After each segment the child was asked to tell the experimenter what happened.

The characters in the movie are a bird, a cat, a chicken, and a rooster, and the movie takes place on a farm. In this clip, the cat tries to catch the bird, and chases after the bird. The bird hides in a henhouse with several chicks and chickens. The cat tries to enter the henhouse but a chicken scares him away, not letting him come in. The cat thinks about ways to steal the bird and decides to trick the chickens by distracting them with a little toy. As the entrance of a little toy soldier into the henhouse distracts chickens, the cat sneaks in and gets the bird from a nest. The little chicks in the nest notice that the cat stole the bird and pull the chicken's legs to let her know. As the cat is running away with the bird, the rooster stops him. The rooster gets mad at him for stealing the bird, and asks him to give the bird back to the chicken. The cat, being scared of the rooster, pretends that he likes the bird by just patting the bird's head, and gives the bird back to the chicken.

2. Interview Method

The Berkeley Puppet Interview (BPI) is a semi-structured interview technique to be used with young children (ages 4½ to 7) in clinical settings (Measelle et al., 1998). In this interview, children are introduced to two identical puppets who make opposing statements about themselves. For example, one puppet (Iggy) says "I have a lot of friends" and the other one (Ziggy) says "I don't have a lot of friends". The child is then asked about himself/herself ("How about you?").

In this study, the puppet interview method was adapted to investigate children's tendency to attribute humanlike characteristics to nonhumans. The content of the questions was inspired by the individual differences scale that was used with adults (Waytz, Cacioppo, et al., 2010) and Piaget's (1929) interviews with children. I have extended the range of anthropomorphic properties Piaget asked about nonhumans, by including questions about thinking, having emotions, personality, knowing, feeling, and perception. I included three questions about natural entities (i.e., clouds, trees, flowers) and three questions about mechanical devices (i.e., bicycles, computers, TVs) to assess children's anthropomorphism. For each item, one puppet made a statement about an anthropomorphic trait (e.g., "I think clouds can have emotions; they can be happy or sad") and the other puppet disagreed (e.g., "I think clouds cannot have emotions"). Children were then asked what they thought. They could point to the puppet they agreed with or state their own opinion. In addition to these six items, the puppet interview included four distracter items that asked about non-anthropomorphic traits of the same entities (e.g., "I think clouds are beautiful"; see Appendix F). The puppet making the anthropomorphic statement as well as the order of anthropomorphic statements within

each trial were quasi-random (with the condition that distracter items were not presented back to back), and this order was kept consistent for all participants.

Assessment of Theory of Mind. In order to assess children's social understanding, I used two behavioral tasks:

1. Contents false belief task (adapted from Wellman & Liu, 2004).

False belief tasks are commonly used in assessment of theory of mind in preschool period. These tasks are highly reliable and yield variability in younger preschoolers. Although my sample had older preschoolers (ages 5 and 6) as well as younger ones, I decided to include a false belief task since it is a well-standardized measure of theory of mind. In this contents false belief task, children were shown a band-aid box and asked what they think was inside. The content was then revealed (a toy bird) and the box was closed. Children were asked to state what was really in the box. Then they were introduced to a toy figure of a girl who was described as never having seen inside the box. Children were asked "What does the girl think is in the box?" They were also asked whether the girl had seen inside the box (control question). Children had to answer both of these questions correctly to pass the task (i.e., "band-aids" as an answer to the first question, and "no" to the second question). Trials on which children failed the control question were coded as missing.

2. Restricted view task (adapted from Chandler and Helm, 1984; Taylor, 1988).

The restricted view task is a perspective-taking task that yields individual differences in older as well as younger preschoolers. Although, it is a less standard way of measuring theory of mind, I decided to include this task to examine individual

differences in perspective taking abilities aspect of theory of mind because it was appropriate for the age range used in this study.

The child was introduced to a puppet (Max) that was wearing a hat that covered his ears and prevented him from hearing anything. The child was shown a drawing of a dog, and asked what it was. After the child answered that it was a drawing of a dog, a cover was placed on the drawing so that only a small but informative part of the drawing was visible (i.e., the dog's face). The experimenter told the child that Max had never seen the drawing before and that he could not hear what they were saying. The experimenter asked the child, "Does Max know this is a drawing of a dog?" The child was then asked to explain his or her answer. The child was asked "why not?" to a 'no' response and "How does Max know?" to a 'yes' response. Then, as a second trial, child was shown a drawing of a turtle. Then a cover was placed so that no part of the drawing was in sight (i.e., only blank paper was visible). The child was again asked the same questions. Children were expected to say "yes" in the first trial when descriptive part of the drawing was visible, and "no" in the second trial. After these two trials, which had clear yes/no responses, the procedure was repeated with three more drawings (rabbit, girl, and deer), which were covered so that small non-descript parts were visible (e.g., part of a rabbit's ear). To be able to pass the three ambiguous trials, children needed to say "no" when asked if Max knew what was under the cover by looking at only small ambiguous part. For each of these five trials, children were given a score of 1, with the possible total score ranging from 0 to 5.

Assessment of Mental State Language: Describe a Friend Task. The describe-a-friend task (Meins et al., 2006) was administered in order to assess children's use of

mental state terms in their descriptions of real people. In this task, children were asked to describe their best friends (see Appendix G) and their descriptions were coded for presence and frequency of mental state terms (e.g., *"my friend likes the color purple")*, and personality traits (e.g., "*my friend is shy*"). This task was administered in order to assess the extent that children use mental state and personality terms when they are asked to talk about real people.

Role Play Assessment. Children were interviewed about their engagement in role play (see Appendix H) and were asked to complete one behavioral role play task. In the role-play interview, children were asked if they had pretend friends, and if so to describe pretend friends, and answer questions about their pretend friends' physical and personality characteristics.

In addition to the interview data, the role-play assessment included a behavioral task that assessed children's ability to engage with an imaginary social partner via telephone. In this task, the experimenter asked children to name one of their friends (a real friend, not a pretend one) and then children were asked to pretend to talk to that friend on a play phone. The child was given a score from 0 to 4 that indexed whether or not he/she (1) interacted with the phone (i.e., pushing the buttons on the phone and/or holding the receiver to his/her ear) (2) talked on the phone, (3) appeared to listen to the other person, and (4) generated a conversation that went beyond stereotyped greetings such as "hi" or "how are you?" (e.g., "*Do you want to have a play date with me?*", "*You want to give me one of your Barbies?*"). Data from one child was missing due to experimenter error, and from two children due to noncompliance with the task. Data from the remaining sample of 70 children were analyzed. Phone conversations for 18

children (25 % the sample) were coded by a second researcher with high reliability (100% reliability for interacting with the phone and talking on the phone, 89 % for listening, and 94 % for conversation content).

Parent Measures

Family Demographics. Parents were asked to fill out a brief questionnaire (12 items) about themselves (e.g., age, occupation, income) (see Appendix I).

Parent Report Theory of Mind Measure (Children's Social Understanding Scale). Parents were asked to fill out a 42-item Children's Social Understanding Questionnaire (CSUS; Tahiroglu, Moses, Carlson, Olofson, & Sabbagh, under review). In this scale, parents were asked to comment on their child's use of mental state language and everyday behaviors that might reflect social understanding (e.g., "*My child talks about differences in what people like or want [e.g., "You like coffee but I like juice], "My child is good at playing hide and seek*."). They were asked to rate their children on a 4-point Likert scale ranging from "Definitely untrue of my child" to "Definitely true of my child". In addition, a "don't know" response option was also provided (see Appendix J). Children were given a score for the CSUS by computing the average of parents' ratings on these 42 questions.

Role Play. Parents filled out a questionnaire about their children's role play behaviors including questions about pretend friends (e.g., age, gender, physical characteristics) (See Appendix K).

Social Preferences. The Child Social Preference Scale (Coplan et al., 2004) includes 11 items to assess shyness and social disinterest. There were four items (two reverse scored) assessing social disinterest – the child's lack of a strong motivation to

interact socially; and seven items (one reverse scored) assessing conflicted shyness – the child's social fear and anxiety despite a desire to be social. Parents were asked to rate the likelihood of their children engaging in specific behaviors *(e.g., My child rarely initiates play activities with other children)* on a 5-point Likert Scale ranging from *'not at all'* to '*a lot'* (see Appendix L for all items). Two subscale scores (shyness and social disinterest) were be computed by averaging across item ratings.

Procedure

Parents were recruited through the developmental psychology database and called on the phone. Children attended a 45-minute long session with one experimenter while the parent filled out questionnaires in an adjacent room. The order of the tasks were the same for all children, and it was as follows: anthropomorphism movies ('exclusion and friendship', 'bullying', 'helping'), control movie, contents false belief task, restricted view task, describe-a-friend, phone task, role play interview, and puppet interview. There were breaks after the movies, and after the role play interview.

Results

Assessment of Anthropomorphism

Interview Method. In an attempt to examine children's ideas about nonhuman agents' humanlike characteristics, six pairs of statements about anthropomorphic traits of nonhumans were presented to children and they were asked to state what they thought. For each pair of items, children's answers were coded as 1 (agreement with anthropomorphic statement) and 0 (agreement with non-anthropomorphic statement). Data from five children were missing due to noncompliance with the task, leaving a final sample of 68 children for the analysis. Thirteen children (majority of whom were 4-year-

olds - 54 %) did not answer at least one of the questions, and/or gave an irrelevant response (e.g., stating that rainbows are beautiful in response to the item about clouds having emotions).

Internal consistency of the six anthropomorphism items was acceptable (α = .76). Anthropomorphism items were generally correlated with each other (*r*s > .26, *p*s <.05). The bike item was marginally correlated with the item about clouds and r (60) = .22, p = .09. The item about flowers correlated only marginally with the item about bikes r (60) = .23, p = .08, and did not correlate with the item about TV (See Table 3). The flower item did not correlate with two items, and there appeared to be a problem with the use of the word "personality" in the question. Children were asked to state their opinion about flowers having personality *(e.g., "I think flowers can have personalities; some flowers can be shy or outgoing" vs. "I think flowers cannot have personalities"*), but most children asked the experimenter what the word "personality" meant. For these reasons, the flower item was dropped from the analysis. However, the pattern of results did not change for the interview measure with and without the flower item.

Due to missing data, children's answers on the five anthropomorphism items were averaged (range of scores between 0 and 1), with higher numbers indicating more anthropomorphic thinking (M = .21, SD = .28). Items about trees and clouds were averaged across to compute an aggregate score of anthropomorphism of nature entities (M = .21, SD = .34) and items about bikes, computers and TVs were averaged across to compute an aggregate score of anthropomorphism of mechanical devices (M = .21, SD = .31). The means were not significantly different from each other, and the two scales correlated highly with each other, r (65) = .50, p < .001.

Table 3. *Correlations between items in the interview measure of anthropomorphism*

	Trees	Clouds	Flowers	Bicycles	Computers
Clouds	.29*				
Flowers	.40**	.36**			
Bicycles	.45**	.21^{+}	.22^{+}		
Computers	.45**	.39**	.26*	.42**	
TVs	.37**	.29*	.05	.35**	.36**

*Note. **p < .01; *p < .05; $^{+}$p < .10 (2-tailed)*

When an exploratory factor analysis was run on the five anthropomorphism items, a one-factor structure emerged, all items loading on one single factor, explaining the 51 % of the variance. Thus, it seems like children did not differ in their anthropomorphism of nature entities vs. mechanical devices, lending support to Waytz, Cacioppo, et al.'s (2010) claim that anthropomorphism (as measured by the interview method) is a general tendency being applied to all sorts of nonhumans. Given the factor solution, and no difference between nature entities vs. mechanical devices, I will focus on overall anthropomorphism scores for the rest of the results.

Overall, children did not anthropomorphize on the interview measure very much. In fact, 36 children (52%) did not agree with any of the anthropomorphic statements. The most frequently anthropomorphized item was TV (33% of children agreed with the anthropomorphic statement), followed by clouds (25%), computers (19%), trees (16%), and bikes (12%). There was no correlation with age and children's anthropomorphism,

r (66) = .06, *p* = .63. There was also no gender difference in the extent children anthropomorphized, *t* (66) = .73, *p* = .47. In a further analysis, I grouped children into two categories: those who did not anthropomorphize any of the items (*n* = 36) and those who anthropomorphized at least one out of five items (*n* = 32). These two groups did not differ on age or gender.

Narrative Method. Children's narratives were coded in two different ways. One method of coding was adapted from Klin's (2000) animation coding index (See Appendix M). Klin created the animation index to measure children's capacity for social attributions. On this index, children were given a score between 0 to 6 based on the highest level of social attribution reached in the narrative (e.g., 'making a decision' implies a hierarchically higher social attribution than 'trying to'). This method's advantages were that it did not rely on the length of the narrative and that it had been used in previous research.

In addition, global impression of the narratives was used to assess the extent children used anthropomorphic language in the narratives on a scale from 0 (non anthropomorphic descriptions) to 5 (highly anthropomorphic descriptions) (See Appendix N for examples of each level). Raters were given instructions to take into account the use of agency, mental state, and personality terms when coding for anthropomorphism. Children received higher scores for attributions of humanlike traits (e.g., mental state terms, personality traits) in their narratives; however, the impression rather than the actual count of mental state words was taken into account. A second rater coded 25 % of the data and inter-rater reliability was high for all movies (*r*s > .85, *p*s < .01).

For the three anthropomorphism movies, the two coding systems were highly positively correlated, *r*s (70) > .50, *p*s < .01. The pattern of the results was the same for both coding schemas, and this pattern did not change when a composite of these two ways of coding was used. Thus, for the purpose of this paper I will only report results using the coding based on global impression because the global impression scoring yielded larger variability (see Table 4).

Table 4. *Scores on the anthropomorphism movies based on two coding systems*

	Exclusion	Bullying	Star	Control Movie (Tweety and Sylvester)
Klin's Animation Index	Range 0-4	Range 0-4	Range 0-4	Range 0-4
	1.69 (*SD* = 1.10)	2.08 (*SD* = .99)	2.07 (*SD* = 1.13)	2.40 (*SD* = .65)
Global Impression	Range 0-5	Range 0-5	Range 0-5	Range 0-5
	1.90 (*SD* = 1.46)	2.71 (*SD* = 1.36)	2.49 (*SD* = 1.33)	3.90 (*SD* = .85)

Scores for the three movies were highly correlated with each other, *r*s (67) > .49, *p*s < .01 (See Table 5), thus I computed an aggregate score of anthropomorphism by averaging across children's scores on three movies that depicted geometric shapes.

The control movie was coded in the same way as geometric shape movies. Although the control movie also required anthropomorphism (e.g., anthropomorphism of animals), I expected that children would be more likely to anthropomorphize animals in this movie than the shapes, due to the high number of agency cues depicted.

Table 5. *Correlations between the three anthropomorphic shape movies and the control movie*

	Exclusion	Bullying	Star	Control Movie (Tweety and Sylvester
Bullying	.57**			
Star	.56**	.49**		
Control Movie (Tweety and Sylvester)	.54**	.61**	.55**	
Mean Anthro.	**.64****	**.60****	**.60****	.67**

Note. Mean Anthro. = average scores on three anthropomorphism movies. Correlations in bold reflect corrected correlations. $^{**}p < .01$ (2-tailed)

As expected, children anthropomorphized the control movie ($M = 3.90$, $SD = .85$) more than the shape movies ($M = 2.41$, $SD = 1.15$), $t\ (69) = 14.56$ $p < .01$. I computed a relative score by subtracting children's anthropomorphism scores on the three geometric shape movies from their scores on the control movie. The difference scores were all positive, meaning that there was not any child who anthropomorphized more in the shape movies than they did on the control movie. The difference scores ranged from 0 to 3.67 with a mean score of 1.49 ($SD = .85$).

The number of propositions (*verb + its complement*) in each narrative was counted to provide a measure of verbal skills. The number of propositions used in the three geometric shape movies were highly correlated, rs $(66) > .56$, ps $< .01$. Thus, I computed an overall language measure by averaging across the number of propositions used in the three anthropomorphism movies. Children used more propositions in their

narratives for the control movie (M = 16.86, SD = 7.53) than they did for the shape movies (M = 11.82, SD = 4.47), t (69) = 8.30, $p < .01$. In addition, language ability was highly correlated with children's anthropomorphism scores on the shape movies and on the control movie (rs > .62, ps < .01), so language ability was controlled for in the following analyses.

Although the control movie triggered more anthropomorphism, children's anthropomorphism scores for the control movie correlated highly with anthropomorphism of the shape movies, r (68) = .67, $p < .01$. This correlation was significant after controlling for age and language (propositions used in the shape movies and in the control movie), r (65) = .50, $p < .01$.

There was a trend level correlation between children's age and anthropomorphism scores on the shape movies, r (71) = .21, p = .08. Children's age correlated significantly with anthropomorphism scores on the control movie, r (68) = .29, $p < .05$. However, these correlations were not significant once language was controlled. There were no gender differences for the anthropomorphism movies or the control movie.

Analyzing the five prompted questions (e.g., *Do you think any of them were mean?*) was not straightforward because even children who used anthropomorphic language in their justifications often differed in their interpretations of the stories. For example, in the bullying movie, our intention was to depict the big red triangle as the mean character bullying the small triangle and the circle. However, 30 % of children thought that the big triangle in this movie was the victim because the small triangle and the circle left him alone. In addition, some children's justifications for their choices were random (e.g., a child picking the red triangle as the mean character in the movie, but

justifying it by stating that the color red is evil). Overall, the data for this measure were problematic, difficult to interpret, and will not be discussed further.

Relation Between the Interview and Narrative Methods of Anthropomorphism. The interview measure of anthropomorphism correlated only marginally with the narrative measure of anthropomorphism of the shape movies (r (65) = .22, p = .07), and the correlation was not significant when age and language (i.e., mean number of propositions used in geometric shape movie narratives) were controlled, r (61) = .04, p = .75. There was a significant correlation between the interview method and anthropomorphism of the control movie, r (63) = .34, $p < .01$. However, this correlation also was not significant when I controlled age and language in the narrative for the control movie, r (62) = .20, p = .11.

Assessment of Theory of Mind

Parent Measure of Theory of Mind. Data from two parents were dropped for the Children's Social Understanding Scale (CSUS) because they had more than 25% missing data. The scale had good internal consistency (α = .86). Parent-reported theory of mind ratings on the CSUS ranged from 2.25 to 3.88 (M = 3.38, SD = .32). The remaining 71 parents' ratings on the CSUS correlated with age r (69) = .30, $p < .01$. There was no gender difference.

Child Measures of Theory of Mind. Data from seven children were coded as missing (either because they did not engage in the task or because they failed the control question). Fifty-six children passed the contents false belief task, and eleven children failed the task. The eleven children who failed the false belief task were younger (Mage = 59.55 months, SD = 10.25) than children who passed (Mage = 66.27 months, SD = 8.47),

t (65) = 2.33, $p < .05$. A chi-square test revealed no gender differences. There was a significant correlation between the CSUS and false belief task performance, r (63) = .42, $p < .01$. This correlation was significant after controlling for age and gender, r (61) = .37, $p < .01$.

The restricted view task data were then analyzed. Although we expected children to pass both warm-up trials, 35 children (50 % of children who answered this question) failed the first warm-up trial where a descriptive part of dog was visible, and children were asked whether the puppet knew that it was a dog. On the other hand only two children failed the second warm-up trial (out of 73 who answered); most children correctly stated that the puppet did not know it was a turtle when a blank piece of sheet was visible.

Given the unexpected variability in the warm-up trials, I decided to include these trials in children's task scores to add variability. Children's responses on five trials were summed to get an aggregate score (M = 3.60, SD = 1.27). These scores did not correlate with age, and there were no gender differences. Aggregate scores of five trials correlated with parent reported theory of mind, r (69) = .26, p = .03. This correlation was significant after controlling for age and gender. In addition, as would be expected, children who failed the false belief task performed worse (M = 2.95, SD = 1.49) than children who passed the false belief task (M = 3.77, SD = 1.19), t (65) = 1.99, p = .051.

I also created a composite behavioral theory of mind score by averaging across six trials of theory of mind tasks (five trials on restricted view task and one trial on the false belief task) (M = .74, SD = .23; *range* = .17 to 1). This composite score was not associated with age or gender. It was correlated with the parent reported theory of mind,

r (69) = .33, $p < .01$, and this correlation was significant after controlling for age and gender, r (67) = .30, $p < 01$.

Role Play Assessment

Imaginary Companions. Children were categorized as having invisible friends and personified objects on the basis of information in the child role play interviews, the parent role play questionnaires, and follow-up interviews.

Invisible friends. Children were categorized as having an invisible friend if the child indicated that he or she has/had an invisible friend and the child or the parent provided a good description of it. To count as having an imaginary companion, the child had to treat the character as if it had its own personality and independent existence (e.g., has a name, might have certain likes or dislikes, is nice or mean, etc.).

Personified objects. The criteria for coding personified objects was similar to the criteria for coding invisible friends, with one addition to differentiate between transitional objects and personified objects. To be categorized as having a personified object, the description of the object (in either the child's or the parent's report) had to go beyond the physical appearance of the object to include psychological details (e.g., "she is nice to me").

Inter-rater reliability was obtained by having a second researcher code all of the data for imaginary companions. There was 92% overlap between the raters in imaginary companion decision - the coders agreed on 67 out of 73 cases. Twenty-six children (36 %) reported having an imaginary companion. Fifteen of these companions (21 %) were categorized as invisible friends, and 11 were personified objects (15%).

Table 6. *Demographics as a function of imaginary companion status*

	No IC	PO	IF
Age	5 years, 4 months (*SD* = 9.21 mo.s)	5 years, 5 months (*SD* = 8.44 mo.s)	5 years, 6 months (*SD* = 9.02 mo.s)
Boys (*n*= 38)	26	5	6
Girls (*n*=36)	21	6	9
TOTAL	47	11	15

There were no age or gender differences in having an imaginary companion, and the type of the companion (See Table 6).

Phone Task. The mean phone score out of 4 was 2.54 (*SD* = 1.19; *range* = 0 to 4). There was a significant gender difference: girls received higher scores on the phone task (*M* = 2.85, *SD* = 1.16) than boys (*M* = 2.25, *SD* = 1.15), *t* (68) = 2.18, *p* = .03. There was no correlation between age and phone task scores, *r* (68) = -02, *p* = .89. Children with imaginary companions scored higher on the phone task (*M* = 3.19, *SD* = 1.06) than children without imaginary companions (*M* = 2.16, *SD* = 1.09), *t* (68) = 3.85, *p* < .01.

Describe a Friend Task. The goal of this task was to assess children's mental state attributions to a real friend. Overall, children did not spontaneously use many mental state terms or personality attributes in their descriptions of their friends. Instead, their descriptions included references to physical and behavioral characteristics of their friends (e.g., "*She has brown hair*"; "*We go to same school*"). To compute children's mental state language use, the number of attributes associated with the friend's mental states and personalities were divided by total number of attributes used to describe the

friend (M = .09, SD = .26). Children's mental state language use was not associated with any of the variables. I then grouped children into two groups: those who included at least one reference to their friend's mental states and/or personalities and those who described their friends on solely behavioral and physical terms. Only 23 (34%) children used any kind of psychological attributions in their descriptions. These children were not different from children who did not use any psychological attributions on any of the demographics, or the test variables (e.g., anthropomorphism, theory of mind, having an imaginary companion), so this task was not analyzed further.

Social Preferences. Parents' ratings on shyness and social disinterest items on the Child Social Preferences Scale were averaged to compute aggregate scores of these variables. Shyness scale scores ranged from 1 to 4.71 (M = 2.29, SD = .81) and social disinterest scale scores ranged from 1 to 5 (M = 2.73, SD = .92). These two subscale scores were correlated, r (71) = .28, $p < .05$, showing that the more shy a child is, the less social interest he or she displays. There were no gender differences on children's score on shyness or social disinterest. Shyness scores did not correlate with age, but social disinterest correlated negatively with age r (71) = -.30, $p < .05$. This finding suggests that as children get older they also show more social interest and stronger motivation to engage in social interactions.

Inter-correlations between Anthropomorphism, Theory of Mind, Role Play Behaviors, and Social Preferences

Interview Measure. As can be seen in Table 7, there was only a marginal correlation between parent-reported theory of mind and the interview measure of anthropomorphism; r (63) = .21, p = .09. When age is controlled, this correlation was not

significant, r (62) = .20, p = .12. There also was no correlation between the restricted view measure of theory of mind and the interview measure of anthropomorphism, r (65) = .13, p = .28. However, there was a correlation between the false belief task performance and the interview measure of anthropomorphism, r (62) = .29, p < .05, and this was significant after controlling for age and gender, r (60) = .30, p < .05. The theory of mind behavioral composite score, however, did not correlate with the interview measure of anthropomorphism. Overall, I did not find much support for the predicted relationship between measures of theory of mind and the interview measure of anthropomorphism.

Having an imaginary companion was associated with higher scores on the interview measure of anthropomorphism, r (66) = .25, p < .05, and this was significant after controlling for age, r (64) = .24, p < .05. There was a marginal correlation between phone task scores and the interview measure of anthropomorphism, r (63) = .22, p = .08, and this correlation did not change after controlling for age.

Parent reported shyness did not correlate with the interview measure of anthropomorphism. But, parent reported social disinterest correlated negatively with interview measure of anthropomorphism, r (65) = -.28, p < .05. This correlation stayed significant when age was controlled, r (64) = -.27, p < .05. Children who showed a stronger motivation to engage in social interactions (as reported by parents) scored higher on the interview measure of anthropomorphism.

Table 7. *Correlations between test variables*

	Narrative-Anthro.	Control Movie	Interview-Anthro.	CSUS	Restricted View	False Belief	Phone Task	Imaginary Companion	Shyness
Control movie	.67** (.50**)								
Interview Anthro.	.22^{+} (.04)	.34** (.20)							
CSUS	-.01 (-.04)	-.08 (-.18)	.21^{+} (.20)						
Restricted View	-.06 (-.13)	.11 (.07)	.13 (.12)	.27* (.24*)					
False Belief	.00 (-.20)	.19 (.00)	.29* (.30*)	.42** (.37**)	.27* (.26*)				
Phone Task	.33** (.16)	.14 (-.05)	.22^{+} (.22^{+})	.03 (.04)	-.12 (-.12)	-.03 (-.02)			
Imaginary Companion	.23* (.04)	.16 (-.04)	.25* (.24*)	.21^{+} (.20)	.09 (.08)	.09 (.08)	.42** (.43**)		
Shyness	-.16 (.03)	-.12 (.01)	-.04 (-.03)	.04 (.10)	-.06 (-.04)	-.24^{+} (-.19)	-.08 (-.09)	-.16 (-.15)	
Social Disinterest	-.12 (.03)	-.09 (.06)	-.28* (-.27*)	-.28* (-.20)	-.06 (-.02)	-.23^{+} (-.16)	-.08 (-.10)	-.14 (-.11)	.27* (22^{+})

Note. Age and language controlled correlations are in parentheses. Mean number of propositions in three geometric shape movies was used as language control for correlations between mean anthro. and others; number of propositions in the control movie was used as language control for correlations between the control measure and others. ***p < .01; *p < .05; $^{+}$p < .10 (2-tailed).*

Movie Measure. Children's anthropomorphism on the geometric shape movies or on the control movie was not associated with theory of mind as measured by parent report, restricted view task, false belief task, behavioral composite theory of mind tasks, and measures of shyness or social disinterest.

There was a significant relation between having an imaginary companion and scores on the movie narrative measure, r (71) = .23, $p < .05$. However, this correlation was not significant when age and language ability were controlled. There was no relation between having an imaginary companion and scores on the control movie.

Children's performance on the phone task also correlated with scores on the movie narrative measure, r (68) = .33, $p <$. 01. Again, this correlation was not significant when age and language ability (the mean number of propositions used in the shape movies) were controlled for, r (66) = .16, p = .19. There was no relation between phone task scores and scores on the control movie.

I then ran a regression analysis to further analyze the relationship between my test variables. When theory of mind measures (i.e., the CSUS, false belief task, restricted view task), imaginary companions, phone task, shyness, and social interest were entered into a regression to predict anthropomorphism scores, none of them were found to be significant predictors of scores on the movie narrative measure. Performance on the phone task was the only marginally significant predictor of the interview measure of anthropomorphism, t = 1.84, p = .07

Other Analyses. Past studies found a relationship between behavioral measures of theory of mind and having an imaginary companion, but there was no association between children's performance on the false belief task, the restricted view task, or the

composite score for behavioral measures and having an imaginary companion in this study. However, children with imaginary companions were rated marginally higher on the parent report of theory of mind (M = 3.47, SD = .21) than children without an imaginary companion (M = 3.33, SD = .36), t (67) = 1.81, p = .08. This difference remained to some extent when age was added as a covariate, F (1, 68) = 2.69, p = .11.

Past studies also found a relationship between shyness and having an imaginary companion: children who had imaginary companions were less shy. However, in this study social preferences (i.e., shyness and social disinterest) were not associated with having an imaginary companion, ts (70) = 1.40 and 1.16, ps > .17, respectively. The social disinterest measure negatively correlated with the parent reported theory of mind, r (68) = .28, p < .05, suggesting that the more children show interest in social relations the better they are at tuning to others' mental states.

Discussion

For this study, I created two measures to assess anthropomorphism that had high internal consistency and yielded individual differences in preschool children. With the interview method, I replicated Waytz, Cacioppo, et al. (2010) and Study 1 findings that anthropomorphism of nature entities and mechanical devices correlate highly and that they load on one factor. Moreover, Waytz et al.'s later analysis also confirmed that even anthropomorphism of animals loaded onto one general anthropomorphism factor. Although I did not collect data from children about anthropomorphism of animals in the interview measure, my findings provide support for the idea that anthropomorphism could be a general tendency in children as it is in adults, applied to most kinds of nonhuman entities, rather than being specific to the type of nonhuman.

For the narrative measure of anthropomorphism, children were asked to describe what happened in silent animations of geometric shapes. Children's anthropomorphic language use was similar across three different movies depicting different interpersonal interactions (e.g., exclusion, bullying, helping). A control movie of animals (i.e., a clip from the cartoon *Tweety and Sylvester*) was used in this study to assess children's capacity to use mental state terms and personality attributions when narrating a movie that was not just geometric shapes. The control movie had many triggers for anthropomorphism (e.g., humanlike face, movement) and as predicted, children used more anthropomorphic terms for the control movie than they did for the shape movies. Children's anthropomorphism for the shape movies was also correlated with the anthropomorphism scores on the control movie, suggesting that children's capacity to attribute mental states to animated entities when narrating a movie was similar regardless of the type of the entity – geometric shapes vs. animals in this case.

This is the first study to use the interview and narrative measures of anthropomorphism with the same group of participants. In past research, these two methods yielded different results in relation to the development of anthropomorphism and in relation to individual differences in adults. Thus, one goal of this study was to examine the relationship between these measures. I did not find correlations between the two measures, suggesting that these tasks might have different task demands. Alternatively, these might be measuring different aspects of a multi-faceted anthropomorphism construct. These results urge us to consider the multifaceted nature of anthropomorphism and will be discussed further in general discussion.

Based on previous research, I expected older children to anthropomorphize more on the narrative measure than younger children. Although there was a marginal correlation between age and scores on the narrative measure of anthropomorphism in the predicted direction, this relation was moderated by verbal ability and disappeared when verbal ability was controlled. Piaget found that children anthropomorphized less on an interview measure as they get older. In this study there was no relation between age and the interview measure of anthropomorphism, possibly because of the restricted age range (4 to 6 years). According to Piaget's theory, children in this age group fall in the same stage of conceptual development, during which anthropomorphism is wide-spread and applied to a wide range of objects. However, contrary to Piaget's claim, children in this study did not anthropomorphize much on the interview measure.

I predicted that children's anthropomorphism scores would be related to their social understanding, more specifically to their mental state attributions to people (i.e., theory of mind). Although performance on the false belief task was correlated with scores on the interview measure of anthropomorphism, other measures of theory of mind did not predict children's anthropomorphism on either measure. This replicates my findings in Study 1, suggesting that perhaps anthropomorphism is more related to other factors than it is related to theory of mind. One alternative correlate of anthropomorphism could be role play. I found that children with imaginary companions generally scored higher on measures of anthropomorphism than children without an imaginary companion. In addition, children who generated pretend conversations on a toy phone were more likely to score higher on the interview measure of anthropomorphism. However, the interpretation of these results should be tempered

because the link between role play and anthropomorphism was not evident in every analysis.

Epley, Waytz, and colleagues (2008) reported several motivational determinants of anthropomorphism in adults, including one's need to be in control over their environment and one's need to be social. In this study with children, I tested the sociality trigger of anthropomorphism in children by asking parents to rate the extent of their children's social interest. Consistent with the hypothesis, children who were rated higher in their motivation to be social anthropomorphized more on the interview measure of anthropomorphism, replicating Epley et al.'s findings in a sample of preschool children. I also explored another aspect of social preferences, the shyness in relation to anthropomorphism. Contrary to previous findings, shyness was not associated with scores on anthropomorphism, measured by the interview and narrative methods.

Taken together, we can speculate that the understanding of other people might be a necessary step in being able to over-extend it to nonhumans, but it was not sufficient to explain individual differences in anthropomorphism in a preschool sample. In this study, anthropomorphism was more related to children's motivation to be social and their role play behaviors than it was to theory of mind.

CHAPTER IV

GENERAL DISCUSSION

Summary of Major Findings

In this dissertation I investigated the development and correlates of anthropomorphism in preschool children and adults. The results of research in this area have been inconsistent regarding development. Using an interview technique Piaget found that younger children anthropomorphize more than older children and adults (1929), but with a movie narrative method Springer and colleagues (Berry & Springer, 1993; Springer et al., 1996) found that 5-year-olds and adults anthropomorphize more than younger children. However, using new versions of both methods in Study 2, I did not find age-related changes on either of the anthropomorphism measures for children from 4- to 6-years of age. Although I cannot make direct comparisons, the interview measure of anthropomorphism yielded similarly low scores for both adults and children.

In addition to looking at developmental trajectories, I examined the correlates of anthropomorphism in a college sample and a preschool sample (ages 4 to 6). I predicted that theory of mind, the understanding that our own and others' behaviors are guided by mental states, would be related to anthropomorphism; individuals who were more tuned to mental states of others were expected to be the ones to extend this framework, attributing mental states to nonhumans as well. This hypothesis did not receive much support. In Study 1, although there were some significant correlations between adults' performance on self-report measures assessing social understanding (i.e., autistic traits, personal distress subscale of the Interpersonal Reactivity Index, and prosocialness) and anthropomorphism assessed with the interview measure, the effect sizes were too small to

be meaningful. In Study 2, there was a correlation between the interview measure of anthropomorphism and performance on a false belief task, but the other measures of theory of mind and anthropomorphism were not correlated.

In both studies, findings were more consistent in suggesting a link between role play and anthropomorphism. In Study 1, adults who reported having a history of imaginary companions scored higher on the anthropomorphism questionnaire. In Study 2, preschool children who had imaginary companions anthropomorphized more on the interview measure. In addition, there was a marginal correlation between a behavioral measure of role play (i.e., the phone task) and the interview measure of anthropomorphism. Children who were more able to generate a pretend phone conversation with one of their friends were more likely to attribute humanlike mental states to nature entities and mechanical devices. These results suggest that individuals who spontaneously engage in anthropomorphism, such as when they are role playing, were somewhat more likely to extend this framework to other nonhumans when tested on an interview measure of anthropomorphism. I also found a relationship between anthropomorphism and social preferences. Children who were rated by their parents as more interested in social interactions scored higher on the interview measure of anthropomorphism than the others. However, these results were not strong, and the results of regression analyses revealed that the only marginally significant predictor of the interview measure of anthropomorphism was the performance on the phone task. Taken together, these results provide some evidence for a relationship between anthropomorphism and role play (as reflected in having an imaginary companion and generation of pretend conversations) and social preferences, but it is important to note

that this relation did not show up in every analysis. Nevertheless, I believe that the results were stronger for the link between anthropomorphism and role play, and social preferences than they were for the link with theory of mind.

In this general discussion, I first discuss methodological issues in an attempt to understand how anthropomorphism should be operationalized and to consider possible reasons why I did not find the predicted relationship between anthropomorphism and theory of mind. Then, I will evaluate the results in relation to links between having an imaginary companion, generation of pretend conversations, and social preferences. I will end with suggestions for future directions.

Measurement Issues

Previous research has assessed anthropomorphism using interviews (such as adult self-report questionnaire or semi-structured interviews) or using behavioral tasks in which participants were asked to narrate movies of animated geometric shapes. Although these two measures are different in their task demands, it has been assumed that they are tapping the same underlying construct of anthropomorphism. However, I found that children's performances on these two measures were not correlated, suggesting that these methods might be measuring different aspects of anthropomorphism.

In previous studies with adults, the movie narrative measure yielded ceiling effects (Berry et al., 1992; Heider & Simmel, 1944), showing that it is easy (almost automatic) for adults to narrate an animated movie of geometric shapes in humanlike terms. The results for children were more diverse; in a previous study using the movie narrative measure, 56 % of children anthropomorphized (Berry & Springer, 1993). However, in Study 2, I used a movie narrative measure with preschool children and found

that 97 % of children anthropomorphized at least one of the geometric shape movies. The difference between Berry and Springer's and my results is substantial. One possible reason could be the age group used in these studies; Berry and Springer's sample included children between 3- and 5-years and my sample included children between 4- and 6-years. Berry and Springer did not provide an age breakdown of children who did not anthropomorphize, but it is possible that many of these children were younger than the children who participated in my study. In addition, the coding system used in the studies might have affected the findings. In Study 2, the movie narratives were coded for language that either included a mental state term (e.g., think, want, know) or indirectly implied attribution of mental states (e.g., trying, taunting). Berry and Springer's coding system was not clearly described in their paper, but it is possible that their criteria for coding anthropomorphism were more stringent. Nevertheless, many of the children in both studies anthropomorphized when tested on a movie narrative measure.

In contrast, scores were much lower for the interview measure of anthropomorphism. In Study 1, adults showed individual differences on the self-report measure (e.g., "*To what extent does the wind have intentions?"*), but most scores were on the low end of the scale (mean score on the IDAQ being 3.80 [*SD* = 1.60] with 76 % scoring lower than five on a ten point scale). Not surprisingly, in Study 2, children did not score highly on the interview measure either; half of the sample (53 %) did not anthropomorphize for any of the five items, and on average only one item out of five was anthropomorphized.

Why do children and adults anthropomorphize more when asked to narrate a movie of geometric shapes than when they are asked to state the extent they think

nonhumans have mental states? One difference between the measures is that the movie narrative method uses strong visual cues (e.g., contingent motion). It is evident from previous studies that visual cues such as humanlike motion speed, humanlike movement, and contingent actions trigger anthropomorphism. In the interview measure, in comparison, there are no visual cues at all (e.g., pictures, motion). Thus, the presence of visual cues might be an important factor in triggering anthropomorphism.

Another difference lies in the way tasks are presented. In the interview measures, participants are asked directly about their beliefs concerning the existence of mental states in nonhumans (e.g., clouds having emotions, wind having intentions). Thus, endorsement of an item on the interview measure might reflect something about the way the participant views the real world. Although some teleological perspectives include the attribution of intentions and emotions beyond humans to nature entities, such as sun and trees, it is not the dominant view in the region where this study was conducted. Thus, to the extent that the interview measure assesses true beliefs, one might expect the scores to be low.

In contrast, narrating a movie of geometric shapes in anthropomorphic terms does not necessarily entail a true belief about the existence of mental states of nonhumans. For example, it is unlikely that participants who stated, "*the triangle had a great idea*" really believed that the triangle was a thinking entity in some real world way. Rather, they probably were describing the movie anthropomorphically because it was a way to structure and communicate what was happening. The literature suggests that this way of talking metaphorically (i.e., relating unfamiliar concepts to more familiar ones in order to better understand the world) is common in adult daily language (Lakoff & Johnson,

1980), and even children younger than 4 years of age are capable of producing metaphorical speech (Winner, 1988).

As discussed in the general introduction, Epley and colleagues (2007) differentiate strong (e.g., really believing in mental capacities of nonhumans) and weak (e.g., similar to metaphorical thinking) forms of anthropomorphism. Although those researchers did not map these forms onto different measures, it seems like the interview measure might be assessing a stronger form of anthropomorphism in which individuals are asked about their beliefs concerning humanlike characteristics of nonhumans. In contrast, the movie narrative measure might be assessing a weaker form of anthropomorphism, in which participants talk metaphorically without a real belief in a triangle having ideas or a circle feeling sad.

Anthropomorphism Applied to Different Types of Nonhumans

The category of nonhumans is broad, including spiritual agents (e.g., God, angels), animals (e.g., fish, dog), nature entities (e.g., wind, tree), and inanimate objects (e.g., chair, computer). Presumably some types of nonhumans might be more likely to be anthropomorphized than others. In previous research three categories of nonhumans were included: animals, nature entities, and technological devices. In an exploratory factor analysis, Waytz, Cacioppo, et al. (2010) found that animal and nonanimal items (nature entities and technological devices) load onto different but correlated factors. In addition, in a confirmatory factor analysis they found that all three item types in the IDAQ (nature entities, technological devices, and nonhuman animals) load onto one general super-factor; suggesting that anthropomorphism might be a general tendency that is applied to all kinds of nonhumans, rather than being specific to the item type.

In Study 1, when I ran an exploratory factor analysis on the IDAQ, animal and nonanimal items loaded on distinct but highly correlated factors, replicating Waytz, Cacioppo, et al.'s (2010) exploratory factor analysis results. Although ratings on animal and nonanimal items were correlated, the animal items on the IDAQ were rated significantly higher than the rest. For Study 2, I used an interview method with the content adapted from Piaget's interviews (1929) and the IDAQ (Waytz, Cacioppo, et al., 2010). Children were asked whether two types of nonhumans (nature entities and mechanical devices) had humanlike characteristics. In order to make the number of items manageable for preschool children, I decided not to use items concerning animals in this interview. But, as in Study 1, I found that items about nature entities and items about mechanical devices loaded on one factor. For the movie narrative measure, I used two types of nonhumans: animals and geometric shapes. The movie with animal characters was anthropomorphized more than the movies with geometric shape characters, but similar to the results for the interview measure in Study 1, the anthropomorphism of animals was correlated with the anthropomorphism of the nonanimal entities (i.e., geometric shapes).

Overall, the results indicate that although there is also a correlation in the extent that participants anthropomorphize different kinds of entities, animals might be distinct from nonanimals. One possible reason for the distinction of animal and nonanimal items (nature entities and technological devices) could be the distinction between living and nonliving entities. All but one of the nature items on the IDAQ was a living entity (i.e., tree) and others were nonliving nature entities (e.g., mountain, ocean, wind, and environment). It is possible that participants were using this living vs. nonliving

distinction to guide their beliefs concerning these entities' mental lives, rating animate entities higher on anthropomorphism.

This distinction between animals and nonanimals could also reflect stronger and more widespread beliefs that animals indeed have mental states. In fact, several lines of research demonstrate that animals (at least some species) not only have emotions, intentions, and desires, but also are capable of understanding something about how these mental states guide behaviors (Call & Tomasello, 2008; Hare, Brown, Williamson, & Tomasello, 2002). Perhaps, it is not surprising to find that participants, overall, rate animals higher on anthropomorphic traits than nonanimals; when endorsing an item concerning mental states of animals, participants might be correct in their beliefs (as opposed to incorrectly believing in cars having intentions).

However, it is interesting that animals were rated higher than nonanimals even though the IDAQ asked about animal species that are not necessarily strong candidates for nonhumans that possess higher cognitive abilities (i.e., fish, insect, cow, reptile, and cheetah). I would expect the difference between animal and nonanimal items to be even greater if participants were questioned about their beliefs in the existence of mental states of primates, such as chimpanzees. The debate concerning the extent that animals have higher-order cognitive abilities is beyond the scope of this dissertation, but differences in participants' beliefs about the mental life of animals might have affected the results for these questions.

Relation between Anthropomorphism and Social Understanding

I expected to find a link between theory of mind (or more generally social understanding) and anthropomorphism for several reasons. First, studies with individuals

with Autism Spectrum Disorder (ASD) show that these individuals who are known to experience difficulties in theory of mind tasks and social interactions did not anthropomorphize animated movies of geometric shapes to the same extent as typically developing individuals (Castelli et al., 2000). The authors suggested that the difficulties experienced in these tasks might be due to the same underlying mechanism. Second, studies using brain imaging techniques report that the same brain regions are activated when participants attribute a mental state to a human story character and when they watch movies of geometric shapes that trigger attribution of mental states (Waytz, Morewedge, et al., 2010). Third, age related changes in anthropomorphism during preschool years reported by Springer et al. (1996) coincide with the timetable for changes in theory of mind. Finally, in previous studies with adults, anthropomorphism predicted variables that are related to social understanding: individuals' self-reported morality judgments, emotion attribution to, and care and concern for nonhumans.

Despite all these reasons for predicting a strong link between social understanding and anthropomorphism, there was little support for this hypothesis. In Study 1, scores on the self-report anthropomorphism scale had weak correlations with self-reported social understanding (as measured by autistic symptoms), empathy, and prosocial attitudes. In Study 2, there was a correlation between one of the theory of mind measures (i.e., false belief task) and the interview measure of anthropomorphism, but none of my theory of mind measures (i.e., false belief, restricted view, parent report) correlated with the movie narrative measure of anthropomorphism.

These results do not rule out the possibility of theory of mind playing some role in the development of anthropomorphism but there is a need to rethink how developing

knowledge about people is related to the overextension of this knowledge to nonhuman entities. In order to describe geometric shapes as characters possessing mental states, children might initially have developed knowledge of those mental states as they pertain to humans. Thus, having some understanding of humans as thinking and feeling entities might be a prerequisite for anthropomorphism. However, it is possible that even a rudimentary understanding of the human mind is sufficient to extend this to nonhumans. At the other end of the continuum, it is also possible that individuals with a very well developed understanding of human mental states do not necessarily extend this knowledge to nonhumans.

Perhaps the extent that theory of mind is extended to others is related to social and personality factors. In both studies with adults and children, I found some evidence of a link between interview measures of anthropomorphism and having an imaginary companion, indicating that individuals who anthropomorphize spontaneously in their role play might also generalize this tendency to other nonhumans. Although this relationship did not show up in every analysis, the results are promising enough to pursue. One possibility is that individual differences in creativity, which has been found to correlate with having an imaginary companion (Mottweiler & Taylor, 2012), might more strongly predict anthropomorphism. In future research, it might be worth exploring this possibility by including a battery of creativity tasks.

In Study 2, there was also some evidence for social preferences triggering anthropomorphism. Epley and colleagues (2007) suggested that a desire to be social could trigger anthropomorphism in adults. In Study 2 with preschool children, parent-reported sociality motivation (e.g., child's desire to be with other children rather than

being alone) predicted children's anthropomorphism scores on the interview measure. That is, children who showed interest in social situations were more likely to attribute mental states to nonhumans when asked explicitly on the interview measure. Overall, evidence for a link between anthropomorphism and role play (which might be a manifestation of creativity), and social preferences seemed more substantial than the evidence for a link between anthropomorphism and theory of mind.

Future Directions

Relationship between Measures of Anthropomorphism in Adults

One goal of this dissertation was to test the relationship between different measures of anthropomorphism. Study 2 was the first study to use versions of both interview and movie narrative methods with preschool children and the results showed that there was no relationship between the measures. Currently, I am conducting a study to investigate whether these measures are also not related in an adult sample. In this follow-up study, I am administering both interview and movie narrative measures of anthropomorphism to children and their parents.

In this study, it will also be possible to assess the correspondence between the responses of children and their parents. Finding a relation between parents' and children's anthropomorphism scores could possibly reflect the role of language in anthropomorphism. Specifically, it is possible that children who are exposed to metaphorical language (as measured by parents' use of anthropomorphic language on the tasks) might be more likely to anthropomorphize. Alternatively, these parents might be more creative or more socially oriented, and could pass on these traits to their children. This follow-up study is a first step in testing whether a relation exists between children's

and parents' anthropomorphism, and if a link is found, future studies could examine this relation to better understand which aspects of parent-child relationship predict this link.

Relationship between Anthropomorphism and Metaphors

The findings from Studies 1 and 2 suggest that social understanding – which would seem to be the most obvious candidate as a correlate of anthropomorphism – is, at best, not a strong predictor of the attribution of humanlike mental states to nonhumans. Although an understanding of the mind might be necessary in being able to overextend this understanding to nonhumans, other factors might be better predictors. One possibility is that how we measure anthropomorphism might be linked to metaphor use. We use metaphors in daily language by mapping unfamiliar/abstract concepts onto familiar concepts in familiar domains in order to understand and explain our experience. Lakoff and Johsnon (1980) discuss a special type of metaphor use, personification (e.g., "cancer finally caught up with him", p. 33), that is not much different from anthropomorphizing in the weaker forms. Perhaps, anthropomorphism as measured by the movie narrative measure could be described as the use of human metaphor for nonhumans. It would be interesting to determine the extent that anthropomorphic language used in the movie narratives is related to the comprehension and production of other types of metaphors.

Controlling for Task Demands

It is possible that children are using anthropomorphic language in the movie narrative measure because they believe that it is what the experimenters are asking them to do. I want to investigate whether children are sensitive to visual cues or whether they are ready to tell a story regardless of the movie shown to them. Thus, in addition to

movies of geometric shapes in which there are contingent action cues to trigger anthropomorphism, I am now also showing children animated movies of geometric shapes moving randomly on the screen without interacting with each other. Although the shapes do move on their own, suggesting self-propelled movement, children use non-anthropomorphic language to narrate the movie, referring to physical attributes and actions of the shapes (e.g., the triangle went up and down) more than the shapes' mental states. These results indicate that children are selective in the use of anthropomorphic language to describe geometric shapes. When they use anthropomorphic language, it is likely to be triggered by cues rather than being entirely driven by the children's desire to please the experimenter.

Strong vs. Weak Forms of Anthropomorphism

In either version of the interview measure (adult self-report and children's puppet interview) it is unclear whether participants truly believed in their answers or, like the movie narrative measure, relied on metaphors. For example, in the interview measure used with children, one of the items asked whether clouds experienced emotions, such as being happy and sad. Children might have (inaccurately) believed in clouds being capable of experiencing emotions or it is possible that they were speaking metaphorically (e.g., likening rain to tears as a sign of clouds being sad). In future research, it would be interesting to develop assessments that distinguish these possibilities. This is a challenging goal, but perhaps more in-depth interviews with children and adults would help to clarify how strongly participants believe in their answers.

Other Aspects of Anthropomorphism

I assessed anthropomorphism by two methods (interview and movie narrative), but there are other aspects of anthropomorphism that might be interesting to explore. A process that is sometimes confused with anthropomorphism is the perception of faces in various patterns found in one's environment (e.g., seeing angry faces in clouds). Epley, Akalis, and colleagues (2008) believe that perceiving faces in one's environment is more related to animism – attributing life to inanimate objects (e.g., mistaking a rock for a wild bear). They claim that perception of faces in everyday objects (e.g., clouds, the grill of a car) is a psychological process that is distinct from anthropomorphism.

One supporting piece of evidence for this distinction between *seeing human* and *thinking human* is that perceiving faces in nonanimals and attributing mental states to nonhumans have different correlates. The perception of faces is linked to vigilance (possibly due to a need to be aware of possible threats in the environment) and anthropomorphism is linked to a need for social connection (Epley, Akalis, et al., 2008). However, the relation between these two processes has not been empirically tested. Currently, I am testing the extent to which children and adults perceive faces and emotions in inanimate objects (e.g., a tomato with a face-like structure that looks angry) and whether this is related to other aspects of anthropomorphism, such as attributing mental states to geometric shapes in a movie or stating that nonhumans have mental states when asked explicitly on an interview measure. I am also investigating the individual differences in the perception of faces and emotions in inanimate objects in order to assess the extent it is linked to emotion understanding and theory of mind.

Humanizing vs. Dehumanizing

Epley, Waytz, et al. (2008) point out that the way people think about nonhuman entities can reveal something about the way they think about other humans. Adults sometimes overextend these attributions to nonhumans (as in the case of anthropomorphism), but they sometimes dehumanize - treat humans as nonhumans, disregarding their mental states. Dehumanization might result from failing to trigger mental state attributions, such as lacking the motivation to understand and predict another's actions. For example, employers who are in power and have little motivation to understand employees' behaviors might not attribute intentions and desires to them, but rather think of them as tools to achieve a goal (Gruenfeld, Inesi, Magee, & Galinsky, 2008). Understanding what triggers anthropomorphism could provide insight into what triggers dehumanizing. Thus, research on anthropomorphism might shed light on the contexts that are associated with treating people as if they do not have emotions, feelings, beliefs, and desires.

Final Thoughts

The groundbreaking research with adults by Epley and his colleagues draws attention to the importance of studying anthropomorphism. In their empirical work they have begun to address the many questions about the functions of anthropomorphism that are raised by their analyses. Developmental research in this area promises to provide important pieces of the puzzle in understanding how and why inanimate objects are transformed into humanlike agents. For example, previous work has shown that the development of a relationship with a stuffed animal can be a valuable tool for providing emotional support and companionship for young children (Sadeh, Hen-Gal, & Tikotzky,

2008). Hopefully the research reported in this dissertation provides some new insights about the development of anthropomorphism, some tools for its measurement, and some directions for future research that will ultimately illuminate its functions.

APPENDIX A

PROSOCIALNESS SCALE FOR ADULTS

The following statements describe a large number of common situations. There are no 'right' or 'wrong' answers; the best answer is the immediate, spontaneous one. Read carefully each phrase and mark the answer that reflects your first reaction. Please use the following scale to indicate the degree to which each statement is true for you:

Never/ Almost never true	Occasionally true	Sometimes true	Often true	Almost always/ Always true
1	2	3	4	5

1. I am pleased to help my friends/colleagues in their activities.
2. I share the things that I have with my friends.
3. I try to help others.
4. I am available for volunteer activities to help those who are in need.
5. I am emphatic with those who are in need.
6. I help immediately those who are in need.
7. I do what I can to help others avoid getting into trouble.
8. I intensely feel what others feel.
9. I am willing to make my knowledge and abilities available to others.
10. I try to console those who are sad.
11. I easily lend money or other things.
12. I easily put myself in the shoes of those who are in discomfort.
13. I try to be close to and take care of those who are in need.
14. I easily share with friends any good opportunity that comes to me.
15. I spend time with those friends who feel lonely.
16. I immediately sense my friends' discomfort even when it is not directly communicated to me.

APPENDIX B

INTERPERSONAL REACTIVITY INDEX

The following statements ask about your thoughts and feelings in a variety of situations. For each statement, indicate how well it describes you by choosing the appropriate number. Read each statement carefully. Answer as honestly as you can. Thank you.

Does not describe me at all	Does not describe me	Describes me somewhat	Describes me well	Describes me very well
1	2	3	4	5

1. I daydream and fantasize, with some regularity, about things that might happen to me. (F)
2. I often have tender, concerned feelings for people less fortunate than me. (EC)
3. I sometimes find it difficult to see things from the "other guy's" point of view. * (PT)
4. Sometimes I don't feel very sorry for other people when they are having problems. * (EC)
5. I really get involved with the feelings of the characters in a novel. (F)
6. In emergency situations, I feel apprehensive and ill-at-ease. (PD)
7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it. * (F)
8. I try to look at everybody's side of a disagreement before I make a decision. (PT)
9. When I see someone being taken advantage of, I feel kind of protective towards them. (EC)
10. I sometimes feel helpless when I am in the middle of a very emotional situation. (PD)
11. I sometimes try to understand my friends better by imagining how things look from their perspective. (PT)
12. Becoming extremely involved in a good book or movie is somewhat rare for me. * (F)
13. When I see someone get hurt, I tend to remain calm.* (PD)
14. Other people's misfortunes do not usually disturb me a great deal. * (EC)
15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments. * (PT)
16. After seeing a play or movie, I have felt as though I were one of the characters. (F)
17. Being in a tense emotional situation scares me. (PD)
18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them. * (EC)
19. I am usually pretty effective in dealing with emergencies. * (PD)
20. I am often quite touched by things that I see happen. (EC)
21. I believe that there are two sides to every question and try to look at them both. (PT)
22. I would describe myself as a pretty soft-hearted person. (EC)
23. When I watch a good movie, I can very easily put myself in the place of a leading character. (F)
24. I tend to lose control during emergencies. (PD)

25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while. (PT)
26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me. (F)
27. When I see someone who badly needs help in an emergency, I go to pieces. (PD)
28. Before criticizing somebody, I try to imagine how I would feel if I were in their place. (PT)

Note. Reverse scored items are marked by *. EC = Empathic Concern Scale, F= Fantasy Scale, PD = Personal Distress Scale, PT = Perspective Taking Scale.

APPENDIX C

AUTISM-SPECTRUM QUOTIENT

Below is a list of statements. Please read each statement very carefully and rate how strongly you agree or disagree with it by marking your answer. There are no right or wrong answers, or trick questions.

Definitely agree	Slightly agree	Slightly disagree	Definitely disagree
1	2	3	4

1. I prefer to do things with others rather than on my own.
2. I prefer to do things the same way over and over again. *
3. If I try to imagine something, I find it very easy to create a picture in my mind.
4. I frequently get so strongly absorbed in one thing that I lose sight of other things. *
5. I often notice small sounds when others do not. *
6. I usually notice car number plates or similar strings of information. *
7. Other people frequently tell me that what I've said is impolite, even though I think it is polite. *
8. When I'm reading a story, I can easily imagine what the characters might look like.
9. I am fascinated by dates. *
10. In a social group, I can easily keep track of several different people's conversations.
11. I find social situations easy.
12. I tend to notice details that others do not. *
13. I would rather go to a library than a party. *
14. I find making up stories easy.
15. I find myself drawn more strongly to people than to things.
16. I tend to have very strong interests which I get upset about if I can't pursue. *
17. I enjoy social chit-chat.
18. When I talk, it isn't always easy for others to get a word in edgewise. *
19. I am fascinated by numbers. *
20. When I'm reading a story, I find it difficult to work out the characters' intentions. *
21. I don't particularly enjoy reading fiction. *
22. I find it hard to make new friends. *
23. I notice patterns in things all the time. *
24. I would rather go to the theatre than a museum.
25. It does not upset me if my daily routine is disturbed.
26. I frequently find that I don't know how to keep a conversation going. *
27. I find it easy to "read between the lines" when someone is talking to me.
28. I usually concentrate more on the whole picture, rather than the small details.

29. I am not very good at remembering phone numbers.
30. I don't usually notice small changes in a situation, or a person's appearance.
31. I know how to tell if someone listening to me is getting bored.
32. I find it easy to do more than one thing at once.
33. When I talk on the phone, I'm not sure when it's my turn to speak. *
34. I enjoy doing things spontaneously.
35. I am often the last to understand the point of a joke. *
36. I find it easy to work out what someone is thinking or feeling just by looking at their face.
37. If there is an interruption, I can switch back to what I was doing very quickly.
38. I am good at social chit-chat.
39. People often tell me that I keep going on and on about the same thing. *
40. When I was young, I used to enjoy playing games involving pretending with other children.
41. I like to collect information about categories of things (e.g., types of car, types of bird, types of train, types of plant, etc.). *
42. I find it difficult to imagine what it would be like to be someone else. *
43. I like to plan any activities I participate in carefully. *
44. I enjoy social occasions.
45. I find it difficult to work out people's intentions. *
46. New situations make me anxious. *
47. I enjoy meeting new people.
48. I am a good diplomat.
49. I am not very good at remembering people's date of birth.
50. I find it very easy to play games with children that involve pretending.

Note. Reverse scored items are marked by *.

APPENDIX D

INDIVIDUAL DIFFERENCES IN ANTHROPOMORPHISM QUESTIONNAIRE

1. To what extent is the desert lethargic?
2. To what extent is the average computer active?
3. To what extent does technology—devices and machines for manufacturing, entertainment, and productive processes (e.g., cars, computers, television sets) have intentions?*
4. To what extent does the average fish have free will?*
5. To what extent is the average cloud good-looking?
6. To what extent are pets useful?
7. To what extent does the average mountain have free will?*
8. To what extent is the average amphibian lethargic?
9. To what extent does a television set experience emotions?*
10. To what extent is the average robot good-looking?
11. To what extent does the average robot have consciousness?*
12. To what extent do cows have intentions?*
13. To what extent does a car have free will?*
14. To what extent does the ocean have consciousness?*
15. To what extent is the average camera lethargic?
16. To what extent is a river useful?
17. To what extent does the average computer have a mind of its own?*
18. To what extent is a tree active?
19. To what extent is the average kitchen appliance useful?
20. To what extent does a cheetah experience emotions?*
21. To what extent does the environment experience emotions?*
22. To what extent does the average insect have a mind of its own?*
23. To what extent does a tree have a mind of its own?*
24. To what extent is technology—devices and machines for manufacturing, entertainment, and productive processes (e.g., cars, computers, television sets)—durable?
25. To what extent is the average cat active?
26. To what extent does the wind have intentions?*
27. To what extent is the forest durable?
28. To what extent is a tortoise durable?
29. To what extent does the average reptile have consciousness?*
30. To what extent is the average dog good-looking?

Note. IDAQ items are marked by *. All items are rated on a 0 (not at all) to 10 (very much) scale.

APPENDIX E

ADULT IMAGINARY COMPANION QUESTIONNAIRE

An imaginary companion is someone who is make-believe; an imaginary person or animal that you talk to or think about a lot. Sometimes an imaginary companion is completely invisible and sometimes it is an object, like a very special stuffed animal or doll.

1. Do you currently have an imaginary companion? yes _____ no _____
   -If yes, is it invisible or is it an object? _____
   -If object, how is this stuffed animal, doll, or object different from other stuffed animals, dolls, or objects?_____
   -Please describe your imaginary companion _____

2. What about when you were younger, when you were a child? Did you have an imaginary companion then? yes _____ no _____
   -If yes, was it invisible or was it an object? _____
   -If object, how was this stuffed animal, doll, or object different from other stuffed animals, dolls, or objects?_____
   -Please describe your previous imaginary companion _____

APPENDIX F

PUPPET INTERVIEW MEASURE OF ANTHROPOMORPHISM

1. Iggy: I think clouds are beautiful.
   Ziggy: I think clouds are not beautiful.
   What about you (child's name)? What do you think?

*2. Ziggy: I think trees cannot think about anything.
   Iggy: I think trees can think about things; they can think about their birthdays or friends.

*3. Ziggy: I think bicycles can hear things; they can hear the cars or people.
   Iggy: I think bicycles cannot hear anything.

4. Iggy: I think flowers sometimes smell funny.
   Ziggy: I think flowers don't smell funny.

*5. Ziggy: I think computers cannot feel anything.
   Iggy: I think computers can have feelings; they can feel pain or cold.

*6. Iggy: I think clouds can have emotions; they can be happy or sad.
   Ziggy: I think clouds cannot have emotions.

7. Iggy: I think computers are easy to use.
   Ziggy: I think computers are not easy to use.

*8. Ziggy: I think flowers can have personalities; some flowers can be shy or outgoing.
   Iggy: I think flowers cannot have personalities.

*9. Iggy: I think TVs cannot know anything.
   Ziggy: I think TVs can know things; they can know when they are turned on or off.

10. Ziggy: I think bicycles go fast.
   Iggy: I think bicycles don't go fast.

Note. Items assessing anthropomorphism are marked by *.

APPENDIX G

DESCRIBE A FRIEND TASK

(a) Do you have a best friend?

(b) What is your best friend's name?

(c) Can you describe [friend] for me?

(d) What do you like about [friend]?

(e) What sort of person is [friend]?

(f) Is there anything else you'd like to tell me about [friend]?

APPENDIX H

CHILD ROLE PLAY INTERVIEW

Now, I am going to ask you some questions about pretending. Some friends are real like the kids who live on your street, the ones you play with. And some friends are pretend friends. Pretend friends are ones that are make-believe, that you pretend are real.

1. Do you have a pretend friend? yes _____ no _____
   If "no": Have you ever had a pretend friend? yes _____ no _____
   If "no", but parent said "yes": Who is (name given by parent)?
2. What is/was your friend's name?
   If many are listed: Which is the one you play with the most?
   (At end, ask child for information about the other ICs.)
3. Was/Is your friend a toy like a stuffed animal or a doll, or was/is it completely pretend ?
   (If child says "completely pretend" confirm by saying: "It's invisible." If child says "no", ask, "Is it toy or doll?")
   Invisible? yes ____ no _____ Toy or doll? yes ____ no ____
4. Is it a person , animal (what kind), or something else (what is it) ?
5. Is it a boy _____ girl _____?
6. How old is (name of pretend friend)?
7. What does (name) look like?
8. How did you meet (name)?
9. When you want to play with (name), how do you get him/her to show up?
10. When you and (name) are together, what do you like to do?
11. Can (name) do anything special? (If child just says yes, ask: Can you tell me about that?)
12. What do you like most about (name)?
13. What do you not like about (name)?

14a. Do you play with (name) a lot or not very much? A lot ____ not very much___
(If "a lot") almost every day_____ less than that_____
(If "not very much") just one time_____ more than that_____

14b. When you play with (name), is it ___ just you and (name) or ___ are there other people there? [If other people, who? ___ friends, ___ brothers/sisters, ___ mom/dad, ___ somebody else (who?)_____]

15. Where does (name) go when s/he is not with you?
16. You know, friends get along most of the time, but sometimes they don't get along. Do you ever have fights or argue with (name)?
17. Does (name) ever try to boss you around or make you do things that you do not want to do?
18. Does (name) always do what you want him/her to do?
19. Does (name) always play what you want to play?
20. Can you tell me why (name) is your friend?

21. [If based on an object] Can you tell me how (name) is different from your other (dolls/stuffed animals/toys)?
22. For previous pretend friends: What happened to (friend)?
23. When did you stop playing with (friend)?
24. Why did you stop playing with (friend)?
25. (If applicable) Can you please tell me about (other ICs)?

APPENDIX I

PARENT DEMOGRAPHICS QUESTIONNAIRE

Please fill out following information about yourself:

1. Gender ___ male ___ female
2. Age _____

3. Your relationship to child:
   _____ Mother
   _____ Father
   _____ Other (please indicate the relationship) _____

4. Education level (please check highest level attained):
   ___ No formal education
   ___ Grade school
   ___ Some high school
   ___ Some college or 2-year degree
   ___ Bachelor's degree (Major: _____)
   ___ Graduate degree (Please specify) _____
   ___ Other (Please specify) _____

5. Religion _____
6. Marital Status : (Please check one)
   ____ Married ____ Single
   ____ Divorced ____ Separated
   ____ Other (Please specify) _____

7. Occupation (self)_____
   Occupation (spouse, if applicable)_____

8. Which category best describes your total annual income?

   ___ less than $25,000
   ___ $25,000-$40,000
   ___ $40,000-$75,000
   ___ $75,000-$100,000
   ___ more than $100,000

9. What is (are) the age and gender of your child(ren) including the child participating in this study?

(M/F) _____ (M/F) _____
(M/F) _____ (M/F) _____

10. Does your child currently attend school?

_____ Daycare number of hours per week _____
_____ Preschool number of hours per week _____
_____ Kindergarten number of hours per week _____
_____ Other (please specify): _____

11. Who looks after your child(ren) when they are not in school? _____

12. Your cultural background/ Race-Ethnicity (please check all that apply):
___ White
___ Black or African American
___ Hispanic, Latino, or Spanish
___ Asian
___ Asian Indian
___ Hawaiian Native
___ Pacific Islander
___ Middle Eastern
___ Alaskan Native or American Indian
__ Other group (Please specify):_____

APPENDIX J

CHILDREN'S SOCIAL UNDERSTANDING SCALE

On the next pages, you will see statements that describe children's everyday behaviors and thinking. We would like you to tell us how well each statement describes your child's behavior and/or thinking. There are no "correct" answers. The skills and behaviors described in the statements develop gradually, and children differ widely in their behavior and ways of thinking. It is these differences we hope to learn about. Please read each statement and decide whether it's a "true" or "untrue" description of your child's thinking and behaving. Use the following scale to indicate how well a statement describes your child:

1 definitely untrue
2 somewhat untrue
3 somewhat true
4 definitely true

Please do your best to respond to all of the items. However, if you cannot answer an item because you have no idea whether your child thinks or behaves in that way, then circle "Don't know" (DK).

My child…

1. Talks about differences in what people like or want (e.g., "You like coffee but I like juice").
2. Tries to understand the emotions of other people (e.g., wants to know why you are crying).
3. Uses words that express uncertainty (e.g., "We might go to the park"; "Maybe my shoes are outside").
4. Understands when s/he is being teased or made fun of.
5. Thinks you can still see an object even if you are looking in the opposite direction. *
6. Is good at playing tricks on others (e.g., acts as if the cookie jar is empty when really it is full).
7. Realizes that experts are more knowledgeable than others in their specialty (e.g., understands that doctors know more than others about treating illness).
8. Talks about how people feel (e.g., "I'm happy"; "She's angry").
9. Talks about what people like or want (e.g., "He likes cookies"; "She wants to go home").
10. Understands that wishes do not always come true.
11. Can tell you how s/he found out about things (e.g., "Sally told me about it"; "I saw it happen at the park"; "I heard it on the radio").
12. Has trouble figuring out whether you are being serious or just joking. *
13. Recognizes that if a person wants something, that person will probably try to get it.
14. Is good at playing "hide and seek" (e.g., is hard to find, does not make give-away noises).
15. Talks about what people see or hear (e.g., "I see a duck"; "She hears a train coming").
16. Talks about what people think or believe (e.g., "I think it's raining"; "He thinks it's bedtime").
17. Talks about differences between her/his beliefs and someone else's (e.g., "You think it's a shark but I think it's a dolphin").
18. Talks about how her/his beliefs have changed over time (e.g., "I used to think that drinking from a cup is hard, now I think it's easy").
19. Talks about people's mistaken beliefs (e.g., "He thought it was a dog but it was really a cat"; "I thought mommy was coming but it was really daddy").
20. Realizes that if s/he does something bad, others may get mad.
21. Understands that hurting others on purpose is worse than hurting others accidentally.
22. Talks about people's intentions (e.g., "He did it on purpose"; "I didn't mean to spill it"; "She's trying to catch the kitten").
23. Understands that just because you want something it does not mean you really need it.
24. When given an undesirable gift, pretends to like it so as not to hurt the other person's feelings.
25. When talking on the phone, behaves as if the listener can actually see her/him (e.g., assumes that the listener knows what s/he is wearing). *
26. Understands the difference between doing something intentionally and doing it by mistake (e.g., someone deliberately taking a toy vs. taking it by mistake).
27. Understands that different people can have different feelings about the same thing (e.g., one child likes a dog but another child is scared of it).

28. Talks about teaching and learning (e.g., says “My dad taught me how to play that game”; “I learned that song at daycare”).
29. Understands that people can perform the same action for different reasons (e.g., throwing a ball could be done with the intention of playing a game vs. with the intention of hurting someone).
30. Takes into account what others want (e.g., takes turns, shares toys, compromises with other children regarding which game to play).
31. Tries to persuade others that their point of view is incorrect.
32. Talks about the difference between the way things look and how they really are (e.g., “It looks like a snake but it’s really a lizard”).
33. Talks about conflicting emotions (e.g., “I am happy to go on vacation, but I am sad about leaving friends behind”).
34. Is good at directing people’s attention (e.g., points at things to get others to look at them).
35. Tells lies that are really easy to discover (e.g., says that s/he did not eat a cookie when there’s chocolate all over her/his face). *
36. Talks about the difference between intentions and outcomes (e.g., “He tried to open the door but it was locked”).
37. Is good at explaining things to younger children.
38. Understands that telling lies can mislead other people.
39. Thinks that s/he cannot be seen if her/his eyes are closed. *
40. Talks about the difference between what people want and what they actually get (e.g., “She wanted a puppy but she got a kitten”).
41. Has difficulty figuring out how you feel from your tone of voice or facial expressions of emotions (e.g., has trouble telling the difference between an angry and a sad voice/face). *
42. Talks about what people know or don’t know (e.g., “I know who it is”; “He doesn’t know where his ball is”).

Note. Reverse scored items are marked by *.

APPENDIX K

PARENT ROLE PLAY ASSESSMENT

Many children enjoy pretending to interact with someone who is not real. For example, they might talk to an invisible character that they have created or that is based on a real person who is not actually present (e.g., a favorite cousin who lives far away). The pretend interactions might also be with a special stuffed animal or doll. For some children, this type of pretend play is frequent and the child is described as having an imaginary companion.

1. Does your child currently have an imaginary companion? yes _____ no _____
   If no, did your child have an imaginary companion in the past? yes ___ no ___

If your child has **never** had an imaginary companion, please skip to Question #16.
If your child has **ever** had an imaginary companion, please continue.

Description of imaginary companion:

2. Is the imaginary companion completely invisible _____ or is it a toy _____?
   If the imaginary companion is a **toy**, does your child treat the toy primarily as a comfort object (i.e., she or he carries it around and/or sleeps with it) or does she or he treat it as if it was another person (e.g., talks to it, listens to what it says, describes its life to others, etc.).
   Comfort object _____ another person _____ both _____
3. What is the name(s) of the imaginary companion(s)?

If your child has many, which one does he or she play with the most?

4. Is it a person, an animal (what kind?), or something else (please describe)?
5. Is the imaginary companion a male, a female, or are you not sure?
6. Does your child talk about the imaginary companion as being a particular age (e.g., 4 years old) or provide any information about its age (e.g., very old, adult, child, infant…)?
7. If the imaginary companion is **invisible**, what do you know about the physical characteristics of the imaginary companion (e.g., size, hair color, clothing)?

If the imaginary companion is a **toy**, please describe the toy:

8. What do you know about the personality and behavior of the imaginary companion (e.g., does your child describe the imaginary companion as being funny, shy)?
9. Can the imaginary companion do anything special (e.g., fly)?

Types of activities with imaginary companion:

10a. When your child is playing with the imaginary companion (please choose one):
____ he or she is almost always alone.
____ sometimes he or she is alone and sometimes other people are involved in the play. If so, who? ___ siblings, ___ parents, ___ friends, ___ other (please describe).
____ almost always there are other people involved in the play. If so, who? ___ siblings, ___parents, ___ friends, ___ other (please describe).

10b. Some parents directly observe their child talking to or interacting with the imaginary companion. Other parents learn about the imaginary companion indirectly – their child tells them about what the imaginary companion is like and what it is doing.

Do you see your child interacting with the imaginary companion? yes ___no ___

Does your child tell you about the imaginary companion? yes _____ no _____

Please describe:_____

11. Does your child make a special voice for the imaginary companion? yes __ no __

Please describe: _____

12. Does your child use the imaginary companion to escape blame (e.g., says the imaginary companion broke the vase) _____, to bargain (e.g., says the imaginary companion gets to stay up late) _____ or does she or he us the imaginary companion in other types of interactions with you? Please describe: _____

Duration and frequency of activities with imaginary companion:

13. How old was your child when the imaginary companion first appeared?

Were there any special circumstances that coincided with the appearance of the imaginary companion (e.g., birth of sibling, move to new place)?

14. For past imaginary companions, when did your child stop playing with the imaginary companion?

Were there any special circumstances that coincided with the disappearance?

15. During the period in which your child had an imaginary companion, how often did your child play with or talk about the imaginary companion?

Only once or twice ____ occasionally __ frequently ____ almost every day __

Your reactions to the imaginary companion:

16. How do you feel about your child having an imaginary companion (if your child does not have an imaginary companion, how would you feel if he or she did)?

very positive _____ comfortable _____ uncomfortable _____

Why do you feel this way?

Additional comments:

APPENDIX L

SOCIAL PREFERENCES SCALE

Please answer the items on this page about the behavior of your child by *circling* one of the numbers following each item. We know that no item will apply to the child in every situation, but try to consider his/her usual or general behavior. Please answer all questions-- there are no right or wrong answers.

How much is your child like that?

Not at all				A lot
1	2	3	4	5

1. My child often seems content to play alone.
2. My child seems to want to play with other children, but is sometimes nervous to.
3. My child is just as happy to play quietly by his/herself than to play with a group of children.
4. My child is happiest when playing with other children. *
5. My child will turn down social initiations from other children because he/she is 'shy'.
6. My child often approaches other children to initiate play. *
7. My child 'hovers' near where other children are playing, without joining in.
8. My child rarely initiates play activities with other children.
9. If given the choice, my child prefers to play with other children rather than alone. *
10. My child often watches other children play without approaching them.
11. Although he/she appears to desire to play with others, my child is sometimes anxious about interacting with other children.

Note. Reverse scored items are marked by *. Social Disinterest items =1, 3, 4, 9; Shyness items = 2, 5, 6, 7, 8, 10, 11.

APPENDIX M

KLIN'S ANIMATION INDEX

This index corresponds to a summary measure of the narrative's general level of social attribution. It includes:

(1) *Behaviors* (*doing something*):

A. Behaviors that necessitate actors or agents, but which are not uniquely or necessarily human behaviors, nor do they necessarily require any attribution of mental or feeling states (e.g., chasing, fighting, destroying).

B. Verbs or behaviors that do not involve an explicit mental state but are uniquely human (e.g., talking, says, or a quotation).

C. Behaviors that are uniquely human by virtue of implied indication of a shared mental state without which the behavior cannot occur (e.g., cheering, celebrating, trapping, hiding).

D. Behaviors that are uniquely human by virtue of direct indication of an awareness by one character of another's mental state, accompanied by an attempt to alter the second character's mental state (e.g., intimidation, deception, trickery, bullying, arguing, joking, rebuffing, taunting).

(2) *Perceptions*:

E. Sensory experiences or attention which are not uniquely human (e.g., look, watch, see, notice).

(3) *Emotions* (*feeling something*):

F. Emotional terms that usually result from a behavior or an action, but which do not necessarily result from a social action, or which are not uniquely human (e.g., happy, sad, scared, mad, alarmed, panicked).

G. Emotional terms which result only from a social situation (e.g., envious, jealous, sulking, bitter, mended his ways, expressing sour grapes, admiration).

(4) *Cognition*, *intention*, *motivation* (*usually thinking something*) :

H. Lower developmental level: mental state terms expressing desire or knowledge (e.g., want to, know, mistake).

I. Higher developmental level: mental state terms expressing beliefs, thoughts, imagination, plans (e.g., pretending, remembering, decision).

(5) *Relationships or personality traits*:

J. Allusion to a person as constrained by his or her features (e.g., big guy, little guy, kid).

K. Allusion to a person as constrained by his or her relationship to another (e.g., is a daddy, mommy, or baby).

L. Allusion to a person as constrained by his or her actions or attribution of personality traits (e.g., to be a bully, friends, companions, curious, timid, shy).

(6) *Symbolic nature*:

M. An acknowledgement of the symbolic nature of an object or shape (e.g., represents, stands for, symbolizes, a home, domain).

This index is scored following a hierarchical procedure, based on level achieved within each category, rather than on frequency of scored categories or specific items. The index was intended to grade overall level of social cognitive sophistication without penalizing participants on the basis of the length of narrative provided. Scores are values in an ordinal scale of 0 to 6.

Scoring Algorithm:

Score Criteria

0 No human agency; mechanistic; geometric reasoning only.
1 A or E or J
2 B or C or F or H or K or M
3 D or G or I or L
4 At least two of D or G or I or L, but not two of the same category
5 At least three of D or G or I or L, but not two of the same category
6 Four of D or G or I or L, but at least one of each.

APPENDIX N

EXAMPLES OF MOVIE NARRATIVE CODING

Narrative getting a score of *0*:

"The square turned into a diamond. The square and pentagon didn't come out at same time and the circle didn't come. They went out at the same time."

Narrative getting a score of *3*:

"Those two guys were doing this. Green came. They jumped over there. This guy got on this. He said XX and they did this. They got like this. Tried to get on… fell. (Yellow square) tried to push this guy away. He is now spiky. This guy turned like a shape like a can. Then a circle came, decided to get on this. Then he fell down. Green tried to get on this (circle). And fell down. The circle slides to get on this one. And it did. He called his friend to come with him when he was all here. (He) decided to come over. "

Narrative getting a score of *5*:

"Triangle and square don't want pentagon to play with them, because they are playing their own game. He (referring to the pentagon) came up and said "please" they said "no". They wanted to move him away so that they could play with themselves. They thought he would be annoying. Ball wanted to play with him. They wanted to play together. He (circle) thought he would not be annoying."

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