

Children's Understanding of Ordinary and Extraordinary Minds

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How and when do children develop an understanding of extraordinary mental capacities? The current study tested 56 preschoolers on false-belief and knowledge-ignorance tasks about the mental states of contrasting agents—some agents were ordinary humans, some had exceptional perceptual capacities, and others possessed extraordinary mental capacities. Results indicated that, in contrast to younger and older peers, children within a specific age range reliably attributed fallible, human-like capacities to ordinary humans and to several special agents (including God) for both tasks. These data lend critical support to an anthropomorphism hypothesis—which holds that children's understanding of extraordinary minds is derived from their everyday intuitive psychology—and reconcile disparities between the findings of other studies on children's understanding of extraordinary minds.

Children and adults worldwide come to understand persons as intentional agents who act in accordance with their perceptions, desires, and beliefs (Flavell & Miller, 1998; Wellman, 1990). Most people also come to entertain ideas about nonhuman or superhuman agents with extraordinary mental capacities (such as deities who are all-knowing) or agents with exceptional perceptual capacities (such as animals with specialized senses or superheroes with X-ray vision). How and when do such concepts of extraordinary or exceptional agents develop? Addressing this question promises to inform fundamental issues in cognitive development, such as the nature of intuitive and counterintuitive ideas, the enculturation of thought, and the cognitive foundations of religion.

Arguably, the ability to appreciate extraordinary or exceptional capacities originates in early childhood and is intimately linked to the development of an understanding of ordinary, human capacities. Children's understanding of persons and minds—their *theory of mind*—undergoes substantial development during the preschool years (Wellman & Liu, 2004), as children increasingly appreciate the subjective nature of perceptions and thoughts. Such development requires that children disambiguate how the world really is from how self and

others perceive and think about the world. Very young children have difficulty understanding this distinction between appearance and reality. When asked about what other people know or believe, very young children tend to answer by simply assessing reality and using that information to infer others' knowledge and beliefs (Wellman, Cross, & Watson, 2001). We refer to this tendency as a *reality bias*.

One early-emerging manifestation of children overcoming this reality bias is their understanding of *ignorance*—an understanding that agents can be unaware of certain facts. By 3 years of age, children understand that ignorance may result from a variety of circumstances, including agents' lack of perceptual access to certain information. For example, older 3-year-olds understand that only those individuals who have looked inside a container will know what the container holds (Pillow, 1989; Pratt & Bryant, 1990). Soon after children develop an appreciation for the distinction between knowledge and ignorance, they begin to appreciate the distinction between reality and belief; they start to understand that others, misled by inaccurate perceptual cues or outdated information, can hold *false beliefs* (Wellman & Bartsch, 1988). In one standard false-belief task—an unexpected contents task (Perner, Leekam, & Wimmer, 1987)—children are shown that a familiar container (e.g., a cracker box) holds something atypical (e.g., rocks). The container is then closed and children are asked what another person, who has not seen in the container, will

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think is inside. When faced with this task, 3-year-olds typically report that the other person will think the cracker box contains rocks, demonstrating a reality bias. Older 4-year-olds, in contrast, report that others will think the box contains crackers, demonstrating their ability to distinguish how the world really is from one's beliefs about the world.

Thus, in the preschool years, children evidence an emerging understanding of human knowledge and beliefs, including some appreciation of mechanisms that yield knowledge and beliefs (e.g., that seeing leads to knowing). But how does an understanding of the mental capacities of nonhuman or superhuman agents emerge? Studying children's developing understanding of extraordinary minds is interesting in its own right and also promises to shed light more generally on children's understanding of ordinary minds. One possibility, stemming from Piaget's (1929/1979) notion that preoperational children anthropomorphize all agents, has been termed the *anthropomorphism hypothesis*. According to this hypothesis (Boyer, 1996), when children first come to attribute constrained knowledge and fallible beliefs to ordinary humans, they attribute similar limitations to all agents. Only later, building on this initial platform, do children differentiate between the limited capacities of ordinary humans and extraordinary agents' less limited capacities.

An anthropomorphism hypothesis is intuitively appealing; even adults tend to think of nonhuman beings, such as God, as human-like (Barrett & Keil, 1996; Gray, Gray, & Wegner, 2007). Indeed, although formal religious doctrine may attribute radically nonhuman, counterintuitive capacities to deities (e.g., total omniscience), in everyday judgments adults tend to think of deities in terms that are more human-like and limited, and thus only moderately counterintuitive (Barrett, 2000; Boyer, 1996, 1998). For example, Barrett and Keil (1996) found that even religious believers well versed in God's omniscience conceptualized God as attending to people's prayers sequentially, rather than attending to all prayers simultaneously, suggesting that they thought of God as subject to some of the same spatiotemporal constraints as humans. If such anthropomorphic tendencies are true of adults, they seem all the more plausible for children.

However, seminal studies by Barrett, Richert, and Driesenga (2001) challenged this anthropomorphism perspective. These researchers asked children (who attended Christian preschools) to reason about the knowledge and beliefs of humans, God, animals, and inanimate objects. In two studies,

using unexpected-contents false-belief tasks, 3- to 7-year-olds reported what their mother, a tree, non-human animals, and God would think is inside a cracker box that contained rocks. Regardless of age or level of false-belief understanding, children typically reported that God would know the actual contents of the box. In another study, these researchers asked 3- to 8-year-olds whether a human, a monkey, God, or a cat that could see in the dark would know the contents of a box that had only a small slit to peer inside and no internal illumination. Children consistently reported that God and the cat would know the contents of the box, both before and after they gained an understanding (at about age 5 years) that humans and monkeys would not know the contents of the box.

Based upon these findings, Barrett and colleagues (Barrett & Richert, 2003; Barrett et al., 2001) have endorsed an alternate *preparedness hypothesis*, which states that "early-developing conceptual structures in children used to reason about God are *not* specifically for representing humans, and, in fact, actually facilitate the acquisition and use of many features of God concepts of the Abrahamic monotheisms" (Barrett & Richert, 2003, p. 300). Further, Barrett et al. (2001) proposed that, "children can have a more accurate understanding of God's agency than that of humans" (p. 54). That is, very young children's tendency to *not* attribute false-beliefs or ignorance to any agent reflects an early supposition of infallible mental capacities; children treat all agents (human and nonhuman) as omniscient. This hypothesis thus advances the intriguing idea that early cognitive biases facilitate rapid awareness of certain counterintuitive ideas, including ideas about the extraordinary qualities of God.

Although intriguing, these findings and the preparedness hypothesis raise several questions, both empirical and conceptual. First, when very young children apparently attribute infallible knowledge and beliefs to persons (or Gods), their answers may simply reflect an early reality bias—they answer by reporting the reality of the situation without considering agents' mental abilities (Evans & Wellman, 2006; Wellman & Bartsch, 1988). The critical question then is what children attribute to God when they *first* start to distinguish between the actual state of reality and people's (often inaccurate) mental representations of that reality; in particular, at the point when they begin to attribute false beliefs or ignorance to humans. At that point, do they attribute fallible knowledge and beliefs to God as well, as proposed by the anthropomorphism hypothesis, or infallible knowledge and beliefs, as

implied by the preparedness hypothesis? At a later age, when children have developed a more robust understanding of fallible mental capacities, around 5 to 6 years of age, both preparedness and anthropomorphism hypotheses might predict that children attribute more infallible mental capacities to God, provided they have been exposed to such information about God. The preparedness hypothesis predicts that such an understanding at age 6 would reflect a *continuation* of children's early default understanding of extraordinary minds. The anthropomorphism hypothesis, in contrast, posits that such an understanding at age 6 indicates that children are beginning to loosen their earlier tendencies to anthropomorphize all agents. To best test these two hypotheses, it is necessary to densely sample children within the proper age range. Further, the data should be analyzed in a sensitive age-related fashion in order to find and assess the critical window when children *first* correctly attribute fallible mental capacities to humans. Barrett et al. (2001) simply grouped 3-, 4-, and 5-year-olds in year-long age blocks that might have masked the critical developmental window during which children first begin to ascribe human-like limitations to nonhuman agents for these social-cognitive tasks.

A second empirical issue concerns the replicability of Barrett et al.'s (2001) findings. This may well be related to the first issue of fine-grained age sampling and analyses, because different samples or different age groupings may differentially capture the critical developmental window. On the one hand, Barrett and colleagues (Knight, Sousa, Barrett, & Atran, 2004) have replicated their findings with a sample of Yukatek Mayan children whose culture has adopted the Catholic God. As well, Richert and Barrett (2005) reported data conforming to a preparedness trajectory for children's performance on a diverse set of knowledge-ignorance tasks. But other researchers offer findings that conflict with those of Barrett and colleagues, and which would be better explained by the anthropomorphism hypothesis (e.g., Giménez-Dasí, Guerrero, & Harris, 2005; Makris & Pnevmatikos, 2007). For example, using a less challenging knowledge-ignorance task, Makris and Pnevmatikos (2007) found that 3- and 4-year-olds reliably attributed ignorance both to a human and to God. These latter findings suggest that, at least for certain mental properties, there may be a developmental period during which young children concurrently believe that human and nonhuman mental capacities are constrained.

Alongside these empirical issues is an important conceptual one. When children attribute accurate

knowledge to God in a false-belief or knowledge-ignorance task, how are they reasoning about such knowledge and beliefs? One interpretation, following from the preparedness hypothesis, is that they are attributing (and prepared to attribute) to God something like omniscience—the capacity to know all things without perceptual access. But the tasks used tell us little about children's appreciation for the mechanisms through which agents acquire their knowledge or beliefs. In past studies, it is unclear whether young children (even 5-year-olds) attributed to extraordinary agents privileged knowledge directly or via certain (ordinary or exceptional) mechanisms. For example, children may have assumed that God had special visual capacities (a moderate extension of human capacities) and thus actually *saw* the contents of the containers. Indeed, Richert and Barrett (2005) found that children as young as 4 years understood that agents with specialized senses (e.g., exceptional hearing or vision) can gain knowledge about certain stimuli that would be elusive to normal humans. Thus, one unaddressed issue concerns when exactly children are able to understand that an agent can possess certain (privileged) knowledge or beliefs *without* the use of perceptual mechanisms. And this is related to whether and when they might attribute anything like omniscience to God.

We addressed these empirical and conceptual issues in several ways. We employed fine-grained age sampling and analyses (on the order of months rather than years) in an effort to reveal, more precisely, the ontogenetic unfolding of concepts of extraordinary minds. We tested children on both false-belief and knowledge-ignorance tasks and, because children develop an appreciation for human agents' ignorance and false beliefs on different timetables, we analyzed the age-related trajectories for these two tasks separately with appropriately different age groupings. Further, and crucially, we addressed the conceptual issue about children's understanding of mechanisms mediating ordinary and apparently extraordinary knowledge and beliefs. Our primary method was to present 3-, 4-, and 5-year-olds with carefully contrasting agents. Specifically, we asked children to report on the mental capacities of ordinary humans (their mother and a young girl), and various nonhuman and superhuman beings, including God. In some cases, we carefully specified, for the child, the capacities and mechanisms possessed by the agent. Two agents were specified as having special perceptual mechanisms for acquiring knowledge: a cat that can see in the dark and a superhero

(Heroman) who possesses X-ray vision. One other agent (Mr. Smart) was described as being able to “know everything,” even without seeing, so Mr. Smart’s knowledge or beliefs did not depend on perceptual mechanisms at all.

Each of these “special” agents was described in a brief but detailed way (see the Appendix). Mr. Smart’s and Heroman’s special powers were also elaborated through brief demonstrations. Note that Mr. Smart was of interest in his own right and also served as a control in relation to God. It is impossible to know the precise information each child had already received about God and surely children did not have equal exposure to tutelage about a sentient God or God’s extraordinary attributes. Therefore, in contrast to God, about whom we provided no information, for Mr. Smart we gave all children exactly the same background information regarding his attributes. If, as predicted by the preparedness hypothesis, children are prepared to pick up on such information, given prior tendencies to think of agents as infallible and all-knowing, then Mr. Smart should be especially easy to appreciate. This set of contrasting agents allowed us to assess the extent to which children appreciated different mental and perceptual capacities as well as the specific mechanisms agents may use to gather information. As a second method for generating information about children’s reasoning about mechanisms, we asked children to explain their judgments. For example, if they judged that an agent knew the contents of a completely darkened container, we asked them how that agent knew that information.

Method

Participants

Fifty-seven children (32 males), ranging in age from 40 to 73 months (M age = 54 months), participated. Primarily, children were of European American descent and lived in a middle- to upper-middle-class Midwestern university community. We densely sampled children in a critical age range (50–56 months) on the hypothesis (established during pilot testing) that, during this period, children would be likely to first understand ordinary humans’ limited mental and perceptual capacities. One child was excluded from the sample because she could not remember the actual contents of the box for the knowledge-ignorance task. Following the interview, when asked what they knew about God, more than half of these children (59%) provided specific details about God (e.g., “He’s very

smart,” “He’s magical and powerful”). Thirty-nine parents agreed to briefly report on their child’s exposure to religious concepts. Almost half of these parents reported that they take their child to a place of worship, most on a weekly or monthly basis.

Procedure

Children were interviewed individually in a quiet location. They were asked about the beliefs and knowledge of various agents (see the Appendix) using two tasks: one a contents false-belief task (Perner et al., 1987) and the other a knowledge-ignorance task (similar to that used by Barrett et al., 2001). Half of the children received the false-belief task first; the others received the knowledge-ignorance task first. Each of the agents was displayed on a 5 × 7 in. laminated card. Importantly, prior studies have shown that children perform equally well on these tasks whether the protagonists are drawings, puppets, or live performers (Wellman et al., 2001). Children were introduced to each agent (see precise language in the Appendix) upon their first exposure to that agent. For each task, children were presented either mom or the girl first. The presentation of the remaining agents was randomized (the girl or mom was presented as the second agent for 2 children, only).

Because prior research suggests that adults who are exposed to anthropomorphic images of God are more prone to make anthropomorphic judgments about God (Barrett & VanOrman, 1996), we assessed whether the presentation of an image representing God would influence children’s judgments about God’s mental capacities. Thus, half of the sample was tested using a blurry nondescript image to represent God (see the Appendix), and the other half received no image and no language alluding to a bodily presence for God.

Measures

False-belief understanding. Children were shown a crayon box and a brown paper bag. The experimenter asked children what they thought was inside the crayon box and then showed them that the box actually held marbles and that the paper bag held crayons. Both containers were closed, and as a memory check, children were asked which container had marbles and which container had crayons inside (all children answered correctly). Children were then asked the following for each agent with regard to the box: “__ has never been in the room with these things before. If we show __

this box, all closed up, [picture of agent approaches the crayon box] what will __ think is inside here?" To minimize anthropomorphic cues, half of the children were not shown a picture representing God nor were told that God had "never been in the room"; they were simply asked, "What will God think is inside here?" To deemphasize Mr. Smart's visual abilities and emphasize his all-knowing capacity, children were asked what Mr. Smart would think is in the box if he stayed across the room, facing away from the box. For each agent, children earned a score of 0 if they attributed a correct belief or 1 if they attributed a false belief. Following each judgment, the interviewer prompted children to justify their answer by asking, "Why will __ think __ are inside?"

Knowledge-ignorance understanding. To assess children's ability to distinguish knowledgeable versus ignorant agents, children were shown two boxes, each with a slit at the top allowing children to look inside. A lamp was positioned above each box. One of the lamps was turned on, illuminating the interior of the corresponding box and revealing a red plastic frog inside. The other lamp was off, and the corresponding box appeared completely empty. Children were first asked to look inside the lit box and to report what they saw. After children reported that the lit box contained a red frog, they were asked to look inside the unlit box. After children reported that they could not see anything inside the unlit box, the experimenter turned on the corresponding lamp, revealing an identical red frog inside. The latter light was then turned off, and the experimenter reminded children, "So, both boxes have a frog inside but you can't see the frog when this one is dark" [pointing at the unlit box]. As a memory check, children were asked whether each box, in turn, contained a frog or was empty (corrective feedback was provided for a few children as necessary). Children were then asked the following for each agent with regard to the unlit box: "__ has never been in this room with these boxes before. If __ comes very close to the top of the dark box, what will __ think is inside here; a frog or nothing?" For this focal question, the experimenter held the agent's picture above the unlit box, facing the contents of the box. To minimize anthropomorphic cues for half of the sample, no picture representing God was presented and children were not told that God had "never been in this room"; they were simply asked, "What will God think is inside here; a frog or nothing?" while the interviewer pointed at the box. To deemphasize Mr. Smart's visual abilities, children were asked what Mr. Smart would

think is in the box if he stayed across the room, facing away from the box. For each agent, children earned a score of 0 if they attributed correct knowledge or 1 if they attributed ignorance. Following each judgment, the interviewer prompted children to justify their choice by asking, "Why will __ think a frog is inside?" or "Why will __ think nothing is inside?"

Results

Before conducting our focal analyses, we determined whether the presentation of an image representing God (along with language alluding to God's physical presence) was related to children's attribution of human-like (i.e., fallible or constrained) mental capacities to God. For the false-belief task, 43% of those children presented the image and language, and 36% of those who neither saw the image nor heard the language, reported that God will think crayons are in the crayon box, $\chi^2(1, 56) = 0.30$, *ns*. For the knowledge-ignorance task, 61% of children presented the image and language, and 64% of those not presented the image or language, reported that God will think nothing is inside the unlit box, $\chi^2(1, 56) = 0.08$, *ns*. Because children who were presented the "anthropomorphic" image and language and those not presented the image and language were equally likely to ascribe fallible capacities to God, they were combined in the focal analyses.

False-Belief Understanding

To be clear in what follows, a "correct belief" refers to the judgment that an agent knows what is actually in the box (its real albeit hidden contents—marbles). "False beliefs" refer to judgments that an agent is mistaken (i.e., will think crayons are inside the crayon box). Preliminary analyses assessed whether some children concurrently attributed human-like, false beliefs to normal humans *and* to extraordinary beings, as expected under an anthropomorphism hypothesis. Many children indeed attributed false beliefs to each of the special agents—Heroman, Mr. Smart, and God—as well as to normal humans (i.e., the girl and mom) at levels significantly different from chance (for details, see Table 1). Of primary interest was whether a pattern of attributing human-like limitations to all agents would be most common when children first began to understand that humans may hold false beliefs. We conducted an

Table 1
Chi-Square Analyses Comparing Children's Attribution of False Beliefs to Both Agents Against Chance

Agent	Heroman	Mr. Smart	God
Mother	$\chi^2(1, 18) = 8.00^{**}$	$\chi^2(1, 21) = 10.71^{**}$	$\chi^2(1, 22) = 14.73^{***}$
Girl	$\chi^2(1, 18) = 5.56^*$	$\chi^2(1, 21) = 8.05^{**}$	$\chi^2(1, 22) = 11.64^{***}$

Note. Eighteen children attributed a false belief to Heroman, 21 to Mr. Smart, and 22 to God.
* $p < .05$. ** $p < .01$. *** $p < .001$.

exploratory analysis of children's false-belief judgments to find an age range during which children typically attributed "correct" beliefs to all agents and an immediately subsequent period during which children attributed false beliefs to ordinary humans. Based upon this exploratory analysis, we divided children into three age groups: 24 in the young group (40.4–52.4 months; $M = 47.7$), 17 in the middle group (52.5–58.9 months; $M = 54.7$), and 15 in the oldest group (59.0–73.4 months; $M = 63.3$). Figure 1 depicts the primary data: the percentage of children who attributed a false belief to each agent, by age group. Three trends are apparent in this graph: (a) with increasing age, children more often attributed false beliefs to mom and the girl; (b) children in all three age groups ascribed correct beliefs to Heroman; and (c) the youngest and oldest children attributed correct beliefs to God and Mr. Smart, whereas children in the middle age group

typically attributed false beliefs to God and Mr. Smart.

Judgments. An initial repeated-measures analysis of variance (ANOVA) for children's attributions of false beliefs with age as a between-subjects factor (3: young, middle, old), and agent as a within-subjects factor (5: mom, girl, Mr. Smart, Heroman, God) revealed a significant effect for age, $F(2, 53) = 6.98, p < .01$, and agent $F(4, 212) = 10.50, p < .001$, and a significant interaction between age and agent, $F(8, 212) = 5.13, p < .001$. For the youngest group, there were no differences between the agents in children's attributions of false beliefs, $F(4, 92) = .57, ns$; children reported that all agents would think the crayon box contains marbles. On a composite measure summing responses for both the ordinary, human agents, these youngest children attributed "correct" beliefs at levels significantly above chance, $t(23) = 2.70, p < .05$, and did so as well on a similar measure summing responses for both Mr. Smart and God, $t(23) = 3.41, p < .01$. Children in the middle group attributed false beliefs to each agent (except Heroman) more often than did the youngest children, $ts(39) > 2.70, ps < .05$. In this group, children affirmed false beliefs at levels above chance on a composite measure of judgments for both ordinary, human agents, $t(16) = 2.70, p < .05$. On a parallel measure, their attributions of false beliefs for God and Mr. Smart were similar to their judgments for mom and the girl, but not significantly above chance. Note, however, that

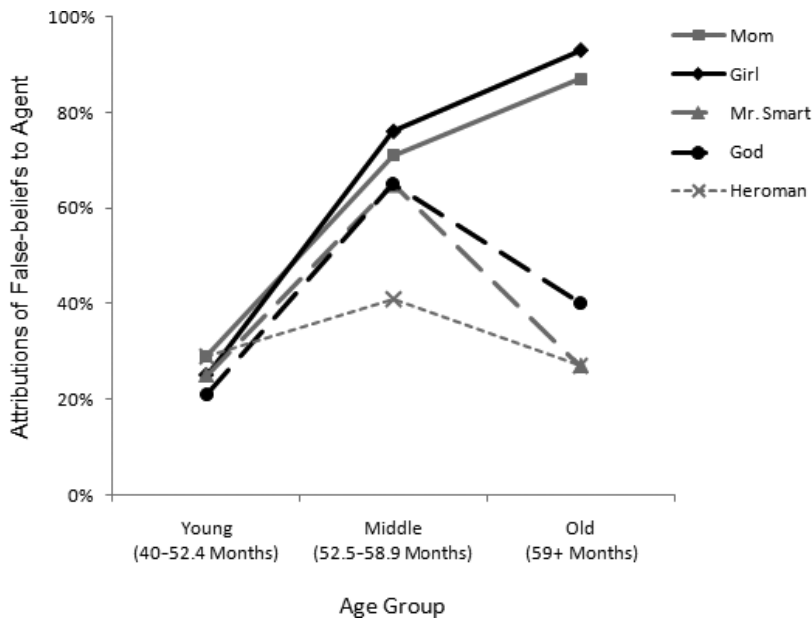


Figure 1. Percentage of children, by age group, reporting that the protagonist will hold a false belief (i.e., will think there are crayons in the crayon box).

Table 2
Coding of Open-Ended Responses

Category	Description	Examples	
		False-belief task	Knowledge-ignorance task
Reality based	Child cites actual contents of the containers. Child does not mention agent's mental or perceptual capacities	"There are marbles inside the box" "The crayons are in the bag" "I saw it in there"	"There is a frog inside" "I saw it in there"
Appearance based	Child cites the appearance of the box	"There are crayons on the box" "It looks like a crayon box" "It says 'crayons'"	"It's dark" "It looks like its empty"
Typicality based	Child cites the type of container or mentions what that the type of box typically holds	"It's a crayon box" "There's usually crayons in a crayon box"	"It's supposed to be in there" "Frogs live in boxes"
Exceptional perceptual capacities	Child cites agent's exceptional senses (vision, hearing) when justifying why the agent will think the true contents are inside	"He has special/x-ray/lit-up eyes" "He can see in the dark" "He heard us talking about the marbles"	"He can see in the dark" "Because he saw it" "Heard us talking about the frog"
Inadequate perceptual capacities	Child cites agent's inadequate, senses (e.g., inadequate vision)	"He can't see through things" "He can't see" "Can't see in closed things"	"It's too dark to see inside" "He can't see" "Light isn't on" [implies agent can't see]
Extraordinary mental capacities	Child cites agent's mental capacities without referring to perceptual capacities	"He's super smart" "He knows everything"	"He's very smart" "He thinks very good"
Inadequate mental capacities	Child cites agent's inadequate mental capacities without referring to perceptual capacities	"He doesn't know crayons are in there" "He doesn't know"	"He's not as smart as Smarty" "She won't know there's a frog inside"

children in this middle group *did not* grant God or Mr. Smart correct beliefs—contrary to what would be expected by a preparedness hypothesis. Only the oldest children (those 59 months and older) consistently reported that Mr. Smart and God would possess correct beliefs whereas the beliefs of mom and the girl would be false, $t(14) > 3.50$, $p < .01$. Children in the middle group, as in the oldest group, affirmed correct beliefs for Heroman (tending to report that Heroman will know the crayon box actually contains marbles) in contrast to the false beliefs of mom, $t(16) > 2.06$, $p < .06$, and the girl, $t(16) > 2.40$, $p < .05$.

Justifications. Children's justifications help clarify the reasoning behind their judgments. Children's justifications were coded into seven categories, as outlined in Table 2, and a residual uncodable category ("don't know"). Twenty percent of the justifications were coded by two separate coders (one blind to all hypotheses and aims of the study) to

assess interrater reliability (all κ s $\geq .96$). We focus on three contrasting agents: Heroman (whose special vision was described), Mr. Smart (who was described as having an extraordinary mind, but no specific exceptional perceptual mechanism), and God (about whom we told children nothing). Table 3 presents data on the primary forms of reasoning that children used to justify these three agents' correct beliefs. Justifications for correct beliefs are particularly revealing because they address which (if any) extraordinary capacities children attributed to these agents.

The youngest children generally did not appreciate these agents' mental capacities or knowledge-collecting mechanisms; rather, they evidenced a reality bias (or said something uninformative). Most of the youngest children said that Heroman would know that the box contains marbles, but fewer than a third referred to his exceptional vision (e.g., "He has super eyes"). Rather, most of these

Table 3
Justifications for Attributions of Correct Beliefs and Knowledge

Age group	Agent	Correct belief reasoning				Correct knowledge reasoning			
		Reality based	Exceptional perceptual capacities	Extraordin. mental capacities	Uninformative	Reality based	Exceptional perceptual capacities	Extraordin. mental capacities	Uninformative
Young	Heroman	24%	29%	6%	35%	29%	14%	14%	43%
	Mr. Smart	17%	6%	28%	33%	13%	—	13%	50%
	God	32%	5%	5%	37%	17%	—	17%	50%
Middle	Heroman	10%	60%	10%	—	18%	73%	—	—
	Mr. Smart	17%	—	67%	17%	33%	—	67%	—
	God	50%	17%	17%	—	67%	—	—	33%
Oldest	Heroman	—	100%	—	—	33%	67%	—	—
	Mr. Smart	—	—	100%	—	35%	5%	60%	—
	God	—	22%	56%	—	42%	25%	17%	17%

Note. Age ranges for the false-belief task are: young (40.4–52.4 months), middle (52.5–58.9 months), and oldest (59.0–73.4 months). Age ranges for the knowledge-ignorance task are: young (40.4–49.4 months), middle (49.5–54.5 months), and oldest (54.6–73.4 months). Extraordin. mental capacities = extraordinary mental capacities.

children justified Heroman's correct beliefs by citing reality (e.g., "There is crayons inside"), confabulating a reason (e.g., "He guessed"), or provided an uninformative response (e.g., "Because" or "I don't know"). In this young group, of the children who said that Mr. Smart or God would think that the crayon box contains marbles (correct belief), only a few provided justifications indicating an appreciation for Mr. Smart's or God's extraordinary mental capacities (e.g., "He's super smart"). Of the remaining children who attributed correct beliefs to Mr. Smart and God, most justified these agents' correct beliefs by citing reality or provided an uninformative response. In sum, when attributing correct beliefs to these special agents (as was typical for these young children, who generally attributed correct beliefs to *all* agents), only 22% of children's responses mentioned anything like exceptional perception or extraordinary mental capacities, although such special capacities were described to children at several points in our protocol.

In the middle group, most children attributed a correct belief to Heroman, and more than half justified their answers by specifically referring to Heroman's extraordinary vision (e.g., "He can look through things"). However, most children attributed to all other agents a false belief. Of the 11 children who attributed a false belief to Mr. Smart, 10 (91%) cited the appearance of the box (e.g., "There's a picture of crayons on the box") or the type of box (e.g., "It's a crayon box"). Similarly, of the 11 children who attributed a false belief to God, 9 (82%)

cited the appearance of the box or the type of box. When attributing correct beliefs to these special agents, children in this middle group cited exceptional perception or extraordinary mental capacities in 55% of their responses.

Just as in their judgments, the oldest children's justifications suggested an appreciation for Heroman's perceptual prowess *and* for Mr. Smart's and God's extraordinary minds. All children in the oldest group who attributed a correct belief to Heroman cited his extraordinary vision, and every child who attributed a correct belief to Mr. Smart cited his mental capacities (e.g., "He's so smart"). Interestingly, of the children who attributed a correct belief to God, about half cited extraordinary mental capacities (e.g., "He knows everything"), but several attributed to God exceptional visual capacities (e.g., "He can see through anything"). Overall, when attributing correct beliefs to these special agents (the typical response for the oldest children), older children appealed to exceptional perception or extraordinary mental capacities 94% of the time. In sum, when attributing correct ("infallible") beliefs to these agents, young children rarely referred to agents' extraordinary perceptual or mental capacities; however, this sort of reasoning was provided often by the middle age group and especially by the oldest children.

Knowledge-Ignorance Understanding

With regard to children's understanding of agents' ignorance, we again first determined

whether some children concurrently attributed human-like, constrained capacities to most agents. For clarification, we use the phrase “correct knowledge” when referring to children’s judgments that the agent knows what is actually in the box (its real but hidden contents—a frog). “Ignorance” refers to children’s judgments that the agent is mistaken (i.e., will think the box is empty). A significant number of children attributed ignorance to each of the special agents—Heroman, the cat, Mr. Smart, and God—as well as to the ordinary humans (i.e., the girl and mom), at levels significantly different from chance (see Table 4 for details). Again, of primary interest was whether this pattern would be most common among children who were just beginning to understand that ordinary humans’ knowledge can be limited by perceptual access. We conducted an exploratory analysis of children’s knowledge-ignorance judgments to find an age

range when children typically attributed “correct” knowledge to all agents, and a subsequent period when children attributed ignorance to ordinary humans. Based on these preliminary analyses, we divided children into three age groups. Because children evidenced an understanding of ignorance at an average age of 4 months younger than an understanding of false beliefs, for knowledge-ignorance analyses there were 12 children in the young group (40.4–49.4 months; $M = 44.2$), 20 in the middle group (49.5–54.5 months; $M = 52.2$), and 24 in the oldest group (54.6–73.4 months; $M = 60.5$). Figure 2 depicts the focal data: the percentage of children who attributed ignorance to each agent, per age group. Three trends are noticeable in this graph: (a) with increasing age, children more often attributed ignorance to mom and the girl, with a later leveling off; (b) children in all three age groups attributed correct knowledge to Heroman

Table 4
Chi-Square Analyses Comparing Children’s Attribution of Ignorance to Both Agents Against Chance

Agent	Cat	Heroman	Mr. Smart	God
Mother	$\chi^2(1, 14) = 4.57^*$	$\chi^2(1, 20) = 7.20^{**}$	$\chi^2(1, 22) = 6.55^*$	$\chi^2(1, 35) = 17.86^{***}$
Girl	$\chi^2(1, 14) = 7.14^{**}$	$\chi^2(1, 20) = 12.80^{***}$	$\chi^2(1, 22) = 18.18^{***}$	$\chi^2(1, 35) = 27.46^{***}$

Note. Fourteen children attributed ignorance to the cat, 20 to Heroman, 22 to Mr. Smart, and 35 to God.
* $p < .05$. ** $p < .01$. *** $p < .001$.

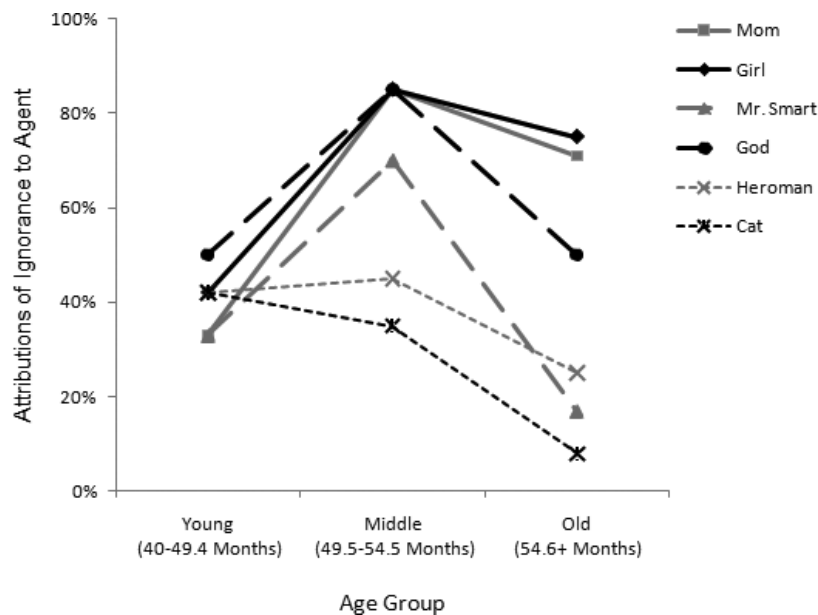


Figure 2. Percentage of children, by age group, reporting that the protagonist will not perceive the contents of the unlit box (i.e., will think that the unlit box is empty).

and the cat, a tendency that was particularly pronounced in the oldest age group; and (c) children in the young and old age groups attributed correct knowledge to God and Mr. Smart, whereas children in the middle age group attributed ignorance to God and Mr. Smart.

Judgments. A repeated measures ANOVA for children's attributions of ignorance with age as a between-subjects factor (3: young, middle, old) and agent as a within-subjects factor (6: mom, girl, Mr. Smart, Heroman, God, cat), revealed a significant effect for age, $F(2, 53) = 4.73, p < .05$; agent, $F(5, 265) = 11.16, p < .001$; and an interaction between age and agent, $F(10, 265) = 3.58, p < .001$. For the youngest children, there were no differences in children's attribution of ignorance between the agents, $F(5, 55) = .61, ns$, and they attributed ignorance to all agents at chance levels. Children in the middle group attributed ignorance to agents (except Heroman and the cat) more often than did the youngest children, $t(30) > 2.09, ps < .05$. They did so above chance on a composite measure of judgments for both ordinary, human agents, $t(19) = 6.66, p < .001$, and notably were above chance on a similar composite measure for both Mr. Smart and God, $t(19) = 3.24, p < .01$. These children (along with the oldest children) distinguished between the correct knowledge of Heroman and the cat and the ignorance of mom and the girl, $t(19) > 2.99, ps < .01$. Notably, in the middle age group, only the two agents who were specified as possessing exceptional vision were judged to know the correct contents of the dark box; God and Mr. Smart were judged to be ignorant. Only the oldest group of children (54 months and older) consistently reported that whereas mom and the girl would think the unlit box is empty, Mr. Smart and God would have correct knowledge that the unlit box contains a frog, all $t(23) > 2.77, ps \leq .01$, except for the difference between mom and God, which was marginally significant at $p < .06$.

Justifications. Children's justifications shed light on the reasoning behind their judgments. Justifications were coded into the same seven focal categories as before (see Table 2). Twenty percent of the justifications were coded by two coders (one unaware of the hypotheses and aims of the study) to assess interrater reliability (all $\kappa_s \geq .88$). We focus on four contrasting agents: Heroman and the cat (whose exceptional visual abilities were described), Mr. Smart (whose extraordinary mind was described but who was not given a special perceptual mechanism), and God (about whom we told children nothing). Table 3 presents data on the

most common forms of reasoning that children used to justify Heroman's, Mr. Smart's, and God's correct knowledge.

For the youngest children, most judged that Heroman and the cat would know that the box contains a frog, but only 1 of these children for each agent referred to special vision ("He can use his light sensy" and "He can see in the dark"). In contrast, most of these children justified these agents' correct knowledge by citing reality (e.g., "I saw a frog") or provided an uninformative response (e.g., "Because" or "I don't know"). In this young group, of the many children who reported that Mr. Smart would know that the unlit box contains a frog, only 1 provided a justification that suggested he appreciated Mr. Smart's extraordinary mind ("He knows everything"), and only 1 of the children who reported that God would know that the box contains a frog cited God's mental capacities ("He knows everything at church"). The remaining children justified Mr. Smart's and God's correct knowledge by citing the real nature of the box, or provided uninformative responses. In summary, when attributing correct knowledge to these special agents (the typical response for the young children, who generally attributed correct knowledge to *all* agents), in only 21% of their responses did the youngest children appeal to exceptional perception or extraordinary mental capacities.

In the middle group, most judged Heroman and the cat to have correct knowledge. Almost all these children provided justifications that specifically referred to these agents' exceptional vision (e.g., "He can see through anything" and "He can see in the dark," respectively). Most children attributed to all other agents ignorance. Of the 14 children who attributed ignorance to Mr. Smart, 4 (29%) justified their responses by citing the appearance of the box (e.g., "It's dark") and 7 (50%) referred to Mr. Smart's inadequate visual capacities (e.g., "It's hard to see"). Similarly, of the 17 children who attributed ignorance to God, 3 (18%) referred to the appearance of the box (e.g., "It's dark") and 10 (59%) justified their responses by referring to God's inadequate visual capacities (e.g., "He can't see in the dark"). When attributing correct beliefs to these four special agents, children referred to exceptional visual capacities or extraordinary mental abilities in 73% of their responses.

The oldest children's justifications suggested a greater appreciation for Mr. Smart's and God's extraordinary mental capacities, in addition to an appreciation for Heroman's and the cat's exceptional vision. Most of the oldest children

judged Heroman and the cat to have correct knowledge, and a majority of these children justified their judgments by explicitly referring to these agents' exceptional visual capacities. Of the children in this group who attributed correct knowledge to Mr. Smart, more than half cited his extraordinary mental capacities (e.g., "He knows everything"), 1 referred to exceptional visual capacities ("He can see anything"), and a third cited reality. Of the children who attributed correct knowledge to God, almost half cited reality, whereas others cited extraordinary mental capacities (e.g., "He knows everything") or exceptional visual capacities. In short, when attributing correct knowledge to these four agents (the typical response for the oldest children), the oldest children cited exceptional perception or extraordinary mental abilities in 63% of their responses.

Discussion

Not only do children everywhere come to understand the basic mental and perceptual capacities of ordinary human agents, they come to entertain ideas about agents with extraordinary capacities, including religious deities. Recent research on children's understanding of extraordinary, nonhuman minds has been aimed at comparing and contrasting two opposing positions: the anthropomorphism hypothesis and the preparedness hypothesis. From the *anthropomorphism* perspective, very young children initially understand all intentional agents as possessing human-like capacities. Three-year-olds fall prey to a reality bias—they do not consider agents' mental abilities and thus fail to distinguish between the state of reality and people's (often inaccurate) mental states. As children begin to appreciate that humans' capacities are limited and fallible, they initially attribute similar limitations to all agents. After developing an understanding of ordinary, human capacities, children can appreciate that certain agents may conceivably have exceptional or extraordinary powers. Thus, to understand extraordinary agents' special capacities, children must overcome or modify their intuitive conceptions of agents and increasingly think in counterintuitive, nonanthropomorphic terms. The alternative *preparedness* perspective proposes that very young children begin life well equipped to understand that certain agents possess nonhuman capacities (e.g., infallible beliefs) because they have an initial "default assumption" that "many superhuman properties are the norm" (Richert & Barrett,

2005, p. 284). Because initially all beliefs are true and all agents infallible, for special agents (God or others when they are explicitly told the agent has superhuman capacities or states) children need merely and easily continue to see them as superhuman.

A crucial developmental difference exists for these two positions. According to the anthropomorphism hypothesis, there should exist a developmental point, once children begin to attribute fallible capacities and states to humans, when they attribute these states to all agents, even agents adults contend are infallible (e.g., God) and children have heard are infallible (perhaps God, but in our tasks explicitly Mr. Smart). For the preparedness hypothesis, on the other hand, because superhuman properties are the default "norm," children need not struggle to reason counterintuitively about such agents and, as a consequence, there should be no developmental point when these agents are attributed fallible, limited capacities or states. For both positions, an intriguing contrast case concerns agents with more limited extension of ordinary capacities, such as night vision or X-ray vision.

In accordance with the anthropomorphism hypothesis, we found that children reliably attributed ordinary, human-like capacities to special agents for both a false-belief task and a knowledge-ignorance task. Children not only did this for God but also did so for agents whose extraordinary mental capacities and exceptional perceptual mechanisms were explicitly described and demonstrated to them. Normatively, children come to understand ignorance before understanding false beliefs; this is true in precise scaling comparisons (e.g., Wellman & Liu, 2004) and is apparent in our own data as well. Accordingly, we found that the age-related developmental period during which children were especially likely to consider most agents' capacities to be human-like differed between these two forms of mental understanding, a sequential pattern that seems to accord more with an anthropomorphism position. A prepared, early understanding of infallibility should generally apply to knowledge and belief; overcoming an early reality bias could more sensibly apply first to developmentally "easier" mental states (ignorance), then more complicated mental states (false beliefs). Thus, it is of note that our data show that these children came to understand the ordinary limits of one and then another mental capacity, and subsequently entertained the counterintuitive suspension of those limits in sequence.

In apparently contradicting the results and conclusions of Barrett and colleagues, the current findings join two other recent studies. Using a different type of knowledge-ignorance task with Greek Orthodox children, Makris and Pnevmatikos (2007) found that 3- and 4-year-olds held that God and a little girl would *both not know* the contents of a closed box. Only at age 5 did participants differentiate between the girl's ignorance and God's correct knowledge of the box's true contents. Similarly, using modified knowledge-ignorance and false-belief tasks with a sample of Spanish children, Giménez-Dasí et al. (2005) found that, compared with 3- and 5-year-olds, their 4-year-olds more often attributed ignorance and false beliefs to God, and this was the case for children who were attending religious as well as those attending nonreligious preschools.

Our data go beyond other results, however, in clarifying how the overall pattern of apparently contradictory findings could arise depending on the way in which children were sampled and grouped. That is, our finding of specific "anthropomorphic" developmental periods (using tasks similar to those used by Barrett et al., 2001) was a product of careful age sampling and precise age-related analyses of the data. Suppose instead we reexamine our data after removing participants to correct for our dense sampling in the middle age range and simply divide our remaining children into three arbitrary age groups. Then only two age-graded linear trends emerge: (a) an increasing tendency to attribute fallible capacities to the girl and mom and (b) a constant trend to attribute "infallible" capacities to God, Mr. Smart, and Heroman. That is, with less precise sampling and age grouping, our data would mimic the trend lines shown in Barrett's work (e.g., Barrett et al., 2001; Knight et al., 2004). But as is clear in Figures 1 and 2, such analyses would actually mask three different trends: (a) an increasing linear trend to attribute fallible mental states to the girl and mom, (b) an apparently constant trend to attribute correct mental states to the cat and Heroman, and (c) a curvilinear trend where, with age, children first increasingly attribute fallible mental states to Mr. Smart and God, and only later attribute extraordinary, correct mental states to those superhuman agents. The latter trend thus parallels the findings of Makris and Pnevmatikos (2007), and also of Giménez-Dasí et al. (2005), and suggest that their data, too, may have emerged from samples and groupings that were able, like our own, to reveal more precise and detailed developmental trends.

Crucially, earlier studies provide limited information on what specific capacities children are attributing to extraordinary agents. The exception is Giménez-Dasí et al.'s (2005) finding that, when asked, 4- and 5-year-olds often justified their answers that God's knowledge was limited by referencing God's limited perceptual capacities. In our more comprehensive assessment of children's reasoning, we distinguished children's appreciation for mental capacities (e.g., infallible beliefs) from their appreciation for perceptual capacities (e.g., night vision). We used two techniques to provide this additional, needed, information: (a) asking children about the knowledge and beliefs of agents with contrasting mental and perceptual capacities and (b) asking children to explain their responses. These techniques jointly revealed that children in the middle age groups appreciated that most humans (such as the girl, mom, and Mr. Smart) as well as God have constrained access to certain information. However, they also reasoned that other agents who possess specific perceptual mechanisms to access information (such as the exceptional visual capacities of the cat and Heroman) may gain knowledge that would be elusive to most humans. It is conceivable that children attributed accurate knowledge and beliefs to Heroman merely because he held "superhero" status, and thus they understood him as being *all-capable* within a pretend world. However, on the knowledge-ignorance task, children treated Heroman just as they treated the cat—an agent who was not presented as a "super" agent. Moreover, for both tasks, children who attributed accurate knowledge and beliefs to Heroman justified their judgments by specifically referring to his *visual* abilities and not to his other exceptional abilities, such as his ability to fly fast.

Only the oldest children appreciated Mr. Smart's and God's extraordinary mental capacities in the absence of exceptional perceptual mechanisms through which knowledge or beliefs could be acquired—Mr. Smart was described as being very smart and knowing everything, but we did not tell children how he acquired information other than saying that it was not based on vision. These data thus provide converging evidence that contradict the preparedness hypothesis, which specifically describes superhuman capacities, such as infallible beliefs, as the default. According to the preparedness hypothesis, children should have simply continued with this default position when taught about Mr. Smart, but they did not. Similarly, only the oldest children understood the extraordinary mind of God, about whom we provided no background

information. Perhaps, in comparison with religiously trained children, the children in our sample lacked knowledge of God's powers, and this is the reason why children in the middle age group tended to anthropomorphize God—they simply had not learned about God's powers. Following the interview, we did ask children what they know about God. Exploratory analyses did not indicate that there were differences in the responses of children based upon their knowledge of God. The children who could provide details about God, for example, were evenly distributed between the three age groups for the knowledge-ignorance task—about a third (35%) were in the middle “anthropomorphic” age group—and these children comprised about half (45%) of the children in the middle age group. Moreover, we found the same trends for God as we did for Mr. Smart, an agent about whom children definitely had relevant background information. However, our measures did not sensitively capture details of children's prior religious instruction, and our parental reports of children's religious exposure were available for only 39 of 56 children. It is important that future research be conducted using similar methods to assess these developing concepts in children who are exposed heavily to theistic ideas.

Although the current results go a long way toward clarifying children's developing ideas about extraordinary minds and exceptional perceptual capacities, they also raise several questions that could be addressed with future research. First, although we found that a substantial portion of children attributed fallible capacities to the two agents described as having exceptional perceptual capacities—Heroman and the cat—we did not find a specific developmental period during which children were particularly likely to anthropomorphize these agents. It is possible that an even finer-grained age sampling and analysis might uncover earlier anthropomorphic windows for children's understanding of exceptional perceptual capacities. Second, our findings do *not* indicate that our oldest children were attributing *omniscience* to Mr. Smart and God, although some researchers have used that term when interpreting their data (e.g., Giménez-Dasí et al., 2005; Knight et al., 2004). Understanding omniscience requires that one appreciates that an agent not only knows the contents of closed containers but also truly knows *everything*—the nature of all past and future events, all scientific facts, everyone's unspoken intentions and dreams, and so on. Rather, our oldest children likely understood God's and Mr. Smart's powers in a much less coun-

terintuitive manner—Mr. Smart and God think like humans, but they know more (about certain tangible things in the here and now) than normal humans. It would certainly be interesting in future studies to address how children come to entertain increasingly counterintuitive concepts of extraordinary mental capacities and how this might eventually lead to a sophisticated understanding of omniscience.

In summary, our data lend critical support to the anthropomorphism hypothesis while also suggesting ways in which this hypothesis might be modified. When these children first began to overcome their initial reality bias and started to understand the limits of human mental capacities (e.g., that ordinary humans possess ignorance and false beliefs), they applied this same understanding to God and to an agent who was described as possessing extraordinary mental capacities. Meanwhile, during this “anthropomorphic” period, children appreciated that knowledge and beliefs may be acquired via highly specialized, nonhuman perceptual capacities—such as eyes that see in the dark. This initial grasp of exceptional perceptual capacities may well act as a bridge to a later understanding of even more counterintuitive, superhuman capacities. By age 5, children understood that agents with special mental capacities, such as the ability to know everything, may possess knowledge and beliefs without necessarily relying on specialized perceptual mechanisms for acquiring that information. Such early abilities to understand extraordinary capacities are indeed impressive. These abilities allow children to begin to grasp religious teachings that are seemingly counterintuitive, such as God's omniscience. But, importantly, this early understanding of the extraordinary is built upon an earlier and more fundamental understanding of the ordinary.

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Appendix

Agent Images and Introductions



Girl

Let's talk about Mary. [Show picture of Mary]



Mom

Let's talk about your mom. [Show picture of mom] It's not really a picture of your mom, but let's say it is.



Cat

This is a kitty cat. [Show picture of cat] This kitty cat has special eyes that let him see in the dark.

Appendix
(Continued)

Heroman

[Show picture of Heroman and say:]

This is Heroman. Heroman has super powers. He can fly very fast so that he can help lots of people all over the world. He *also has eyes* that let him see the insides of things, he can even see through walls.

[Show child a pen] Can you see this pen? [Place pen out-of-sight, behind paper]

Now can you see the pen? [Place picture of Heroman on child's side of the paper]

Well, Heroman can still see the pen. He can see through the paper and see the pen on the other side.

Remember, Heroman can fly very fast and can see right through things.



Mr. Smart

[Show picture of Mr. Smart, facing the child (away from the box) and say:]

This is Mr. Smart. Mr. Smart has special powers. He knows everything.

[Show child closed opaque container that has a ball inside]

Do you know what's inside here? [Child responds: "No"]

Well, this is the first time that I've played with this, so I don't know what's inside either. Mr. Smart *also* hasn't played with this before. But because he's so smart he still knows what's inside. We would have to look inside, but he wouldn't even need to look.

Mr. Smart, what do you think is in here? [Lean next to Mr. Smart]

Mr. Smart thinks that there is a ball inside. Let's see. [Open container and show child the ball]

Mr. Smart was right! Wow, he knows everything!

Remember, Mr. Smart is very smart. He knows everything.

[Place Mr. Smart face-down, away from box]



God

Let's talk about God. [Show picture] It's not really a picture of God, but let's say it is.

Note. Picture representing God (and language alluding to God's physical presence) was only presented to half of the sample.