

**CHILDREN'S DEVELOPING CONCEPTS OF ORDINARY AND
EXTRAORDINARY MINDS: THE ROLES OF INTUITIVE THEORIES AND
CULTURAL INPUT**

by

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DEDICATION

To my parents, Fran and Robert,

my grandma, Ruth,

and my brother, David

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ABSTRACT

Individuals worldwide entertain ideas about beings with extraordinary mental capacities that far surpass ordinary human limits. How and when do such concepts develop? Two theories have been proposed to account for this development. A *preparedness* hypothesis states that young children are prepared to understand all minds as infallible, perhaps omniscient. A contrasting *anthropomorphism* hypothesis states that children's understanding of extraordinary minds builds upon their initial understanding of ordinary, limited minds. I assess these hypotheses in three studies.

In Study 1, secularly-schooled preschoolers completed theory-of-mind tasks about the mental states of contrasting agents, including ordinary humans, God, and Mr. Smart—whom children were taught “knows everything.” Consistent with an anthropomorphism hypothesis, 4-year-olds who were beginning to attribute mental limits to ordinary humans (e.g., ignorance) attributed those limits to God and to Mr. Smart. Only 5-year-olds differentiated between humans' fallible minds and extraordinary beings' less fallible minds. In Study 2, religiously-schooled preschoolers completed identical tasks, revealing a similar developmental pattern: 4-year-olds beginning to attribute certain limits to humans also attributed those limits to God. However, religiously-schooled 4-year-olds did not attribute those limits to Mr. Smart, whose powers they had just been instructed about. Across both studies, children who were more

knowledgeable about God attributed to extraordinary beings less fallible capacities, but this was true only among children who understood ordinary humans' mental fallibilities.

Using different tasks with preschoolers, elementary-school children, and adults, Study 3 revealed that older preschoolers grant all-knowing beings knowledge of many (though not all) domains, including knowledge that ordinary people cannot easily acquire. Understanding the depth of all-knowing beings' knowledge (i.e., knowledge of everything *within* a domain) was not robust until early adulthood. Older preschoolers' exposure to ideas about God predicted attributions of broader knowledge to a new all-knowing being. Results from Studies 2 and 3 suggest that, after developing a representational theory-of-mind, socio-cultural input can facilitate an appreciation for extraordinary minds. Study 3 additionally identifies other cognitive competencies that support an understanding of omniscience. Collectively, these studies reveal that young children are clearly not prepared to understand extraordinary mental capacities, but instead such understanding develops progressively throughout childhood.

CHAPTER I

Introduction

Children's developing understanding of how others perceive, think, and behave—their theory of mind (ToM)—has received intense empirical attention during the past three decades (for reviews, see Astington, Harris, & Olson, 1988; Flavell & Miller, 1998; Harris, 2006; Wellman, 1990, 2011). This work has yielded a wealth of information about the sequence and timing of ToM development, identifying both the universal nature as well as cross-cultural differences in ToM development (e.g., Lillard, 1998; Sabbagh, Xu, Carlson, Moses, & Lee, 2006; Tardif, Wellman, Fung, Liu, & Fang., 2005; Wellman, Cross, & Watson, 2001; Wellman, Fang, Liu, Zhu, & Liu, 2006; Wellman & Liu, 2004). Other studies have identified a multitude of behavioral and cognitive predictors, outcomes, and correlates of ToM development, shedding light on factors that contribute to the emergence of ToM (e.g., Carlson & Moses, 2001; Carpendale & Lewis, 2004; Cutting & Dunn, 1999; Hughes et al., 2005; Wellman, Lane, LaBounty, & Olson, 2011) as well as the role ToM plays in children's everyday lives (e.g., Dunn & Cutting, 1999; Lalonde & Chandler, 1995; Taylor & Carlson, 1997).

Most of the existing work on ToM development has focused on children's understanding of a particular type of mind—an ordinary human mind that is characterized by a specific set of constraints and failings; for example, ignorance and false beliefs. However, children (and adults) also entertain notions of minds that are distinctly non-

human—for example, animals or superheroes with exceptional perceptual abilities like x-ray vision or night vision, and religious deities with extraordinary mental abilities, like the ability to read minds or foretell the future. Relatively little empirical attention has been granted to children’s developing understanding of these non-human, extraordinary minds. The studies in this dissertation address three broad research questions with regard to children’s developing understanding of extraordinary minds: (1) How and when do children *begin* to understand that certain beings possess extraordinary knowledge, and what does this initial understanding look like? (2) What steps are involved in developing a full-fledged understanding of omniscience—an understanding of what it means to know everything about *everything*? (3) What role does cultural input play at different points in this conceptual development?

Addressing these questions will inform the field of cognitive development in several respects. First, results promise to further clarify how very young children understand the capacities and constraints of ordinary, human minds and can provide further information about the role of cultural input on ToM development more generally. Second, because concepts of extraordinary minds are (arguably) counterintuitive—extraordinary minds violate our intuitions about the capacities and constraints of ordinary human minds—results promise to inform us about the acquisition, development, and function of counterintuitive concepts. Third, since non-human perceptual capacities are found throughout the animal kingdom—for example, in bats, hawks, dogs, and sharks—this research will help describe and explain how children develop concepts of the natural biological world. Finally, these studies will shed further light on the early development of religious concepts; particularly concepts of sentient supernatural beings. “As H.L.

Mencken put it, the existence of religion illustrates humans' 'stupendous capacity for believing the incredible'. The study of religion thus has the potential of informing us about aspects of the developing mind that might not be evident from the study of other domains" (Bloom, 2007, p. 148).

In the following sections, I discuss how adults conceptualize extraordinary minds, and will introduce competing views on how children develop concepts of extraordinary mental abilities. Attention is given to the influence of children's cognitive architecture (their intuitive theories of the world) and the influence of cultural input upon developing concepts of extraordinary capacities.

Adults' Detection and Understanding of Extraordinary Minds

Why is it that humans create (or are at least susceptible to believing) concepts of invisible agents like the Judeo-Christian God in the first place? An emerging body of research in the cognitive science of religion has started to address this question (for reviews, see Barrett, 2000; Bering, 2006; Boyer, 2003). Several cognitive biases prime us to believe in sentient, powerful (yet unseen) beings, like the Judeo-Christian God; these include biases to detect agency and attribute intentionality, as well as biases towards artificialism and teleological reasoning. As social beings, we spend much of our time considering others' thoughts and feelings, but such mental inferences are not reserved for our conspecifics; indeed, we attribute mental states to things that are not even alive. For example, in a now classic study, after viewing a film with simple shapes (a big triangle, a small triangle, and a small circle) moving and interacting physically, adults described the shapes' movements in terms of their underlying mental and emotional states, including their motives (Heider & Simmel, 1944). Results like these point to what Guthrie (1980,

1993) has termed a *hyperactive agent-detection device*—a mechanism that biases people to detect agency in the environment even when agents do not really exist. Our tendency to over-attribute agency may have served an evolutionary function—if bushes were rustling, it was more adaptive for ancient humans to assume that an animal was in the bushes, since failing to assume there is an agent when in fact there is one (such as a carnivorous animal), might result in severe consequences. Such a detection device may be partially responsible for why humans often attribute the occurrence of natural phenomena—including the weather, births, deaths, and human origins—to invisible agents, including gods.

Two other cognitive bias that may lead to the generation and acceptance of ideas about a supreme, sentient being are *artificialism*—a tendency to believe that things (including humans and animals) are the product of a creator, and *teleological reasoning*—a tendency to think that entities or events exist for a particular purpose. During middle childhood, children begin to understand that animals and humans do not live eternally—they did not always exist and they will not continue to exist indefinitely (Poling & Evans, 2004; Spence & Brent, 1984). This leads children to question (a) *how* humans and animals originally came into existence, and (b) *why* humans and animals came into existence (Poling & Evans, 2004). Drawing upon their understanding of how artifacts are formed, children develop the intuition that all things have creators, a tendency termed *artificialism* (Piaget, 1969/1929). Artificialism is prominent in children’s reasoning about the natural world, and children who are initially faced with existential questions often rely on such an understanding to account for human origins—someone or something must have made humans as well (Evans, 2000a; Kelemen, 2004).

In a series of studies, Evans (2000b, 2001) asked children closed- and open-ended questions about the origins of living beings and artifacts. To account for the origins of animals, the youngest children interviewed (5 to 7 years) generated and endorsed both *spontaneous generation* reasoning (e.g., “it grew from the Earth”, “it appeared”) and *creationist* reasoning (in which God, a human, or another creature created or placed the animal on Earth). Slightly older children (8 to 10 years) almost exclusively used creationist reasoning to account for animals’ origins. Interestingly, 8- to 10-year-olds appealed to creationist ideas regardless of whether they were raised in religious or non-religious households (Evans, 2001). In contrast, 10- to 12-year-olds typically appealed to the dominant views in their culture—creationism among children from fundamentalist families and a mixture of creationism and evolution among children from non-fundamentalist families. Thus, the idea that humans were created typically emerges during middle childhood, and is common among children from both religious and non-religious backgrounds.

But *why* were humans created? Teamed with a tendency towards artificialism and with a bias to over-attribution intentionality, an intuitive way to answer this question, beginning in middle childhood, is to use teleological reasoning—humans exist *because of* God’s (or some other agent’s) will (Bering, 2006; Evans & Wellman, 2006). Indeed, around and age 7 or 8, children also begin to entertain the notion that invisible beings can intentionally affect the physical world (Bering & Parker, 2006). Although some adults may reject teleological explanations when reasoning about the existence of the Earth, humans, and other entities, such individuals may still use teleological explanations to

address the *personal* question “why am *I* here?”, and this reasoning may drive individuals to hold beliefs that they exist because of some divine entity’s will (Bering, 2006).

In addition to these cognitive biases, there is a strong emotional appeal to believing in superior sentient beings who orchestrate the world. In describing his *theory of emotional coherence*, Thagard explains that “people adopt and maintain religious beliefs for a combination of evidential and emotional reasons that provide satisfaction of cognitive and emotional constraints” (2005, p. 64). According to this theory, some theistic religions have emotional appeal because their concept of God has a positive valence, attracting individuals. Other religions that espouse deities with negative valences (i.e., that are feared) may attract individuals by prescribing practices that can be used in order to appease such beings. Recent research has found that belief in an agentic God has a range of emotional and social benefits (Epley, Waytz, & Cacioppo, 2007; Waytz, Gray, Epley, & Wegner, 2010), and religiosity more generally has well-established mental-health benefits (Miller & Thorensen, 2003). These benefits are a product, in part, of the sense of purpose and meaning that religious ideologies provide—reasons for why we exist, why the world is unjust, why we experience pain, and accounts of what happens after death—and, importantly, having meaning in life is one of the three “routes to happiness” identified by positive psychologists (Peterson, Park & Seligman, 2005; Seligman, Steen, Park, & Peterson, 2005).

Thus, several cognitive biases as well as emotional and social needs predispose humans to detect minds, to believe in supernatural sentient beings, and to reason that such beings are accountable for natural phenomena. But what *kinds* of minds are we predisposed to represent? Although religious doctrine may grant deities with radically

non-human, counterintuitive capacities, like omniscience, in their day-to-day thinking, even religious adults tend to conceptualize deities in more ordinary, human-like terms (Gray, Gray, & Wegner, 2007; Shtulman, 2008). For example, Barrett and Keil (1996) found that religious adults (who reported believing in God's omniscience and omnipotence) in their everyday thinking, often conceptualize God as possessing many mental and physical constraints—for example, able to perceive some people's prayers better than others, and attending to people's prayers sequentially rather than attending to all prayers simultaneously. This suggests that even religious *adults* intuitively think of gods as human-like and limited in many ways, and thus only minimally or moderately counterintuitive (Barrett, 2000; Boyer, 1996, 2000).

Indeed, anthropological work demonstrates that the most successful religious concepts and folktales—those that are consistently transmitted across many generations—violate only a small set of assumptions about ordinary/intuitive physics, biology, or psychology (Atran, 2008). This successful transmission is a product of the concepts being easily represented (because they primarily contain intuitive concepts), yet attention-grabbing, interesting, and thus memorable because of their few counterintuitive elements (Boyer, 1996; Boyer & Ramble, 2001; Boyer & Walker, 2000). Recent psychological work lends additional support to this theory, revealing that minimally or moderately counterintuitive ideas are indeed more memorable than ideas that are completely intuitive or extremely counterintuitive (Atran, 2008; Boyer & Ramble, 2001; Norenzayan, Atran, Faulkner, & Schaller, 2006; Rojahn & Pettigrew, 1992). Ideas that are extremely counterintuitive (like the concept of a truly omniscient, omnipotent, omnipresent deity) are particularly difficult to represent and remember, and are thus less

like to be transmitted across generations. Of note, the God depicted in the Old Testament and New Testament—a being who has survived cultural transmission for millennia—has many human-like, and thus intuitive characteristics, including jealousy, anger, poor judgment, ignorance, and regret (Pickover, 2001).

Children's Understanding of Ordinary Minds

To understand how children come to conceptualize extraordinary minds, it is important to first identify what “theory of mind” refers to and to identify how children develop an understanding of ordinary minds. Broadly construed, “theory of mind” refers to our ability to attribute mental states to others, including intentions, desires, knowledge, beliefs, pretence, and so on (Astington, Harris, & Olson, 1988; Flavell & Miller, 1998; Gopnik & Wellman, 1992; Wellman, 1990). The phrase “theory of mind” became popularized in psychology after Premack and Woodruff (1978) wrote their article, “Does the chimpanzee have a theory of mind?” in which they presented studies that they took as evidence that chimpanzees are able to infer others’ mental states. Though the methods that the researchers used to gauge chimpanzees’ theory of mind have fallen out of fashion (many scholars concluded that chimpanzees’ performance on the tasks could simply be attributed to their use of observable behavioral cues), the terminology that Premack and Woodruff used remained popular, especially among developmental psychologists. The influence of this article on later developmental research went beyond use of the phrase “theory of mind.” In their replies to Premack and Woodruff’s article, several philosophers (Bennett, 1978; Dennett, 1978; Harman, 1978) offered a study paradigm that, they felt, would better reveal whether an animal does actually possess a theory of mind—a

switched-location false-belief task, now a staple of research on children's theory-of-mind development (Wimmer & Perner, 1983).

In current developmental research, the term “theory” is used in the way that it is used in the tradition of the theory-theory (Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1992; 1994; Wellman & Gelman, 1998). The underlying assumptions of the theory-theory are that our knowledge of the world is organized in a coherent manner into theories about different domains—for example, theories of mind, biology, and physics. The development of these theories is a function of both children's current understanding of the world and new evidence that children confront. For example, a theory of mind develops as we observe and interact with others, but the extent to which these observations and interactions force conceptual change is constrained by children's existing theory of mind—thus, conceptual development is the product of a constant interplay between theory and evidence. These theories serve important functions: children (and adults) use them to interpret and make predictions about their world. In the case of a theory of mind, children and adults may consider multiple pieces of information when observing a behavior—aspects of the context, the actor's physical behavior, the actor's traits—and use that information to infer the actor's mental states. For example, if we see a child open a toy chest and retrieve a candy bar, we have enough data to make several mental inferences—the child *wanted* candy, *knew* that the candy bar was in the chest, and *intentionally* retrieved the candy bar. We can also use what we already know about other's mental states to predict people's future behavior, emotional and psychological reactions to new situations, and so on—for example, if that child runs out

of candy, he may *ask* his mother for candy, and he will be *happy* if his mother gives him a candy bar.

The current studies examine how children come to appreciate extraordinary minds. Potentially, a developing ability to appreciate extraordinary mental capacities may be connected to a developing understanding of ordinary, human mental capacities (Evans & Wellman, 2006). Research conducted over the past three decades has revealed a general pattern of theory-of-mind (ToM) development that unfolds during the first five years of life. By the end of the first year, infants understand that people hold intentions that influence their physical behavior, and they understand that intentions vary from person to person (Brandone & Wellman, 2009; Hamlin, Hallinan, & Woodward, 2009; for review see Woodward, 2009). Building upon this initial understanding of intention, by 2-years children have a rich understanding of desires—they understand that different people hold different desires, can predict people’s behavior based upon their individual desires, and understand the emotional consequences of having desires go fulfilled or unfulfilled (Repacholi & Gopnik, 1997; Wellman & Woolley, 1990).

Many later ToM developments require that children disambiguate how the world really is from how self and others perceive and think about the world. By 3-years of age, children understand that ignorance may result from a variety of circumstances, including agents’ lack of perceptual access to information. For example, older 3-year-olds understand that only those individuals who have looked inside a container will know what the container holds; others will be ignorant (Pillow, 1989; Pratt & Bryant, 1990). However, 3-year-olds typically only pass these tasks when they do not themselves hold the correct knowledge; otherwise they over-attribute their own knowledge of reality to

others (Birch & Bloom, 2003). This early confusion likely stems from a more fundamental difficulty that children have understanding the distinction between appearance and reality (Flavell, Flavell, & Green, 1983; Flavell, Green & Flavell, 1986; Woolley & Welman, 1990; but see Hansen & Markman, 2005). Thus, when asked about what other people know or believe, young preschoolers often answer by simply assessing reality (either referring to their own knowledge of the world or by perceiving readily-accessible information in the here-and-now) and using that information to infer others' knowledge and beliefs (Birch & Bloom, 2003; Wellman et al., 2001; Wellman & Bartsch, 1988). This tendency has been referred to as *intellectual realism* (Flavell et al., 1983), a *reality assessment strategy* (Wellman & Bartsch, 1988), and a *curse of knowledge* (Birch & Bloom, 2003). In keeping with terminology used in cognitive psychology literature on heuristics that we commonly use to interpret our world, I will simply refer to this tendency as a *reality bias*.

One early-emerging manifestation of children overcoming this reality bias is evident in older preschoolers' distinction between reality and belief; they start to understand that others, misled by inaccurate perceptual cues or outdated information, can hold *false beliefs* (Perner, Leekam, & Wimmer, 1987; Wellman & Bartsch, 1988; Wimmer & Perner, 1983). That is, children appreciate that we do not simply possess some mental representations of the world and lack others; rather, some of our representations of the world are completely wrong. In one standard false-belief task—an unexpected-contents task (Perner et al., 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 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. Four-year-olds are similarly proficient on other types of false-belief tasks, which contain different protagonists, objects, manipulations, and questions (for meta-analysis, see Wellman et al., 2001).

Several studies now demonstrate a similar sequence of ToM development—from understanding desires, to knowledge, to beliefs—in the US, China, Australia, and Iran (Wellman & Liu, 2004; Wellman et al., 2006; Shahaean, Peterson, Slaughter, & Wellman, in press), and in children with developmental delays and disabilities (Peterson & Wellman, 2009; Peterson, Wellman, & Liu, 2005), using cross-sectional and longitudinal research designs (Wellman, Fang, & Peterson, 2011). Children's ToM continues to develop well into middle childhood (Harris, 2006; Peterson, Wellman, & Slaughter, in press), but since the studies in this dissertation focus specifically on children's understanding of extraordinary agents' knowledge and beliefs, I will not review literature here on children's later ToM developments.

Thus, early childhood is a period of rapid social-cognitive development. During the preschool years, children come to understand how and under what conditions individuals possess knowledge and beliefs, and additionally understand how some mechanisms (e.g., vision) yield knowledge and beliefs. But how do children develop an understanding of non-human or superhuman minds; the minds of beings who are never ignorant or who do not hold false beliefs? Examining this question is interesting in its

own right and also promises to shed additional light on children's appreciation for the capacities and constraints of ordinary, limited minds. One possibility, drawing upon Piaget's (1969/1929) notion that preoperational children anthropomorphize *all* agents, has been termed the *anthropomorphism hypothesis* (Barrett & Richert, 2003). According to this hypothesis, when children first understand that ordinary humans have a particular mental constraint (e.g., the potential to hold false beliefs), they attribute similar constraints to *all* agents. Then, after children have a firm understanding of that mental constraint, they can begin to differentiate between the constrained capacities of ordinary humans and the less constrained capacities of extraordinary beings. Thus, the sequence in which children come to appreciate certain ordinary mental constraints (e.g., false beliefs or ignorance) might parallel the sequence in which they can represent agents whose abilities surpass those constraints. In the following section, I discuss the anthropomorphism account in further detail.

Children's Anthropomorphism of Extraordinary Minds

Much of the research and theorizing about conceptual development conducted over the last half century was motivated by or directly stemmed from Piaget's theories of cognitive development. Psychologists' understanding of children's concepts of extraordinary minds is no exception, and Piaget's stance on this matter was essentially taken for granted by researchers throughout the late 1900s. Piaget's discussion of children's understanding of God was often centered on childhood artificialism—children's tendency to consider all things (natural kinds and artifacts) to be intentionally created; either by humans or by God (Piaget, 1969/1929). Thus, Piaget's reasoning on

children's understanding of God's omniscience was often made in passing, as part of a larger argument about artificialism:

“Our results entirely support the thesis of M. Bouvet according to which the child spontaneously attributes to his parents the perfections and attributes which he will later transfer to God if his religious education gives him the opportunity. In the problem that concerns us now, it is, therefore, man who is thought to be omniscient and all-powerful, and it is he who has created all things... In short, God is either a man like other men, or else the child is always romancing when he speaks of him, in the same way that he speaks of Father Christmas and the fairies.” (1969/1929, p. 354).

Here and elsewhere (e.g., Piaget, 1997/1932) Piaget explains that children conceptualize God as being much like their parents, and vice versa. Piaget however wavers on whether parents are initially thought to be God-like or if God is thought to be parent-like.

“Insistence on divine perfection means setting up in God a rival to the parents, and M. Bouvet has quoted some very curious factors to illustrate this point. If, on the other hand, such insistence is not made and the child is left to his spontaneous conceptions he finds nothing very sacred about God. He is just a man like anyone else, who lives in the clouds or in the sky, but who, with this exception, is no different from the rest.” (1969/1929, p. 381)

“It has been said that the child ‘divinifies’ his parents. M Bouvet retorts with reason that it can better be said that he ‘paternalises’ God, at the moment when he ceases to regard his parents as perfect....Either God is a person or men are gods, or else God is the chief of men, but it is by the transference of the filial sentiment” (1969/1929, p. 382).

Thus, Piaget’s stance was that young children, during preoperational and concrete operational stages of cognitive development, attribute the same mental abilities to God as they do to their parents; not because of deep-seated psychodynamic reasons (as per Freud’s reasoning; 1989/1927) but because children conceive of God as being similar to adults in many ways—large, older, caring. Several researchers have attempted to explain children’s developing understanding of God by relating it to progression through Piaget’s stages of cognitive development. According to Piaget’s general theory, as children progress through concrete operations and enter formal operations, they are able to entertain increasingly abstract notions (Piaget, 1983). Thus, guided by this theory, one would expect that, not until around age 12, when children enter formal operations, can they begin to consider abstract ideas of the sort embedded in theological depictions of God—omnipotence, omnipresence, omniscience, and eternal life (Elkind, 1964; Elkind, 1970). There is some empirical support for the notion that development of God concepts parallels progression through Piaget’s stages, becoming more abstract with age. For example, when asked what God looks like, younger children (5- to 8-year-olds) more often respond in concrete terms (e.g., “Brown hair, blue eyes), whereas older children (9-

to 16-year-olds) provide more abstract reasoning (e.g., “No one knows, no one has ever seen him”) (Nye & Carlson, 1984).

However, now knowing that children reach certain developmental milestones much earlier than Piaget proposed, one may expect God concepts to emerge much earlier in development. It is also clear now that a single logical structure does not underlie conceptual development in all domains, as proposed by Piaget; rather, conceptual development progresses at a different rate and timing in different domains of knowledge (Gelman & Kalish, 2006; Gopnik & Meltzoff, 1997; Wellman, 1990; Wellman & Gelman, 1998). Thus, one may expect that certain concepts of the extraordinary will emerge earlier than others—for example, an understanding of omnipotence (which involves children’s understanding of biology and physics) may develop on a different timetable compared to an understanding of omniscience (which involves children’s understanding of psychology).

In sum, an anthropomorphism hypothesis may be a viable account of how children develop and understanding of extraordinary mental abilities—children may first think of all minds in limited, human terms, and then later in development, differentiate between the ordinary and extraordinary minds of different beings. This hypothesis seems even more plausible when considering that religious adults often think of non-human beings, such as the Judeo-Christian God, as constrained in human-like ways (Barrett & Keil, 1996; Gray, Gray, & Wegner, 2007). If adults are prone to anthropomorphizing the minds of extraordinary beings, such tendencies seem all the more likely for children. However, some theorists have recently proposed an alternative *preparedness* hypothesis, which states that children can not only resist anthropomorphizing extraordinary beings,

they are actually *prepared* to understand extraordinary minds. A discussion of the preparedness hypothesis and empirical work that inspired this hypothesis follows.

Children's Preparedness to Understand Extraordinary Minds

Until recently, children's understanding of extraordinary minds received little direct empirical attention. Speculation about children's understanding of extraordinary minds was often made in passing—for example, when discussing their findings of young children's over-attribution of knowledge to certain familiar adults, Wimmer, Hogrefer and Perner (1988) referred to an “omniscient adult” phenomenon (p. 393). The first direct attempt to systematically examine children's earliest understandings of extraordinary minds came with the publication of studies by Barrett, Richert, and Driesenga (2001), which challenged the anthropomorphism perspective. These researchers asked children (who attended Christian preschools and camps) 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 typically reported that God and the cat would know the contents of the box, both before and after they gained an understanding (at about 5-years of age) that humans and monkeys would not know the contents of the box. Barrett and colleagues have replicated their findings with a sample of Yukatek Mayan children,

whose culture has adopted the Catholic God (Knight, Sousa, Barrett, & Atran, 2004). 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.

Based upon these findings, Barrett and colleagues (Barrett et al., 2001; Barrett & Richert, 2003) 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 and colleagues (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 non-human) 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, findings from Barrett and colleagues and the preparedness hypothesis itself raise several empirical and conceptual questions, including questions about how to integrate these findings with contrasting results from other research groups (e.g., Giménez-Dasí, Guerrero, & Harris, 2005; Makris & Pnevmatikos, 2007), questions about the reasoning that children used when making their decisions (e.g., were they just referring to reality or were they really thinking about God's all-knowing mind?), and questions about the specific capacities children attributed to God. I address these questions with Studies 1 and 2.

Approaching an Understanding of Omniscience

At whatever age children do begin to understand that a special agent will hold privileged knowledge in the tasks described above (i.e., when children appreciate that an agent will know the contents of a container without ever perceiving the contents through typical sensory means), this does not necessarily mark a full-fledged understanding of omniscience. Omniscience refers to an agent's ability to know *everything*, not just readily-accessible information about the here-and-now. Perhaps children's appreciation that some special agents can know contents of containers without seeing those contents marks the very beginning of a developing appreciation for extraordinary mental abilities—the first of many steps involved in achieving an appreciation for omniscience. However, studies have yet to address children's developing understanding of the expanse of an omniscient being's knowledge. Do children think that omniscient beings know about things that happened in the past or the future? Perhaps an all-knowing being has access to the contents of boxes, but what about the contents of others' minds? What other personal information do children attribute to all-knowing beings; knowledge of others' preferences, behaviors, personal events? I address children's understanding of the scope of an all-knowing being's knowledge with Study 3.

The existing literature also says little about how deep children consider an omniscient being's knowledge to be. Within a given domain, do children attribute all knowledge to an all-knowing being (consistent with adults' understanding of omniscience), most knowledge, or just some knowledge? To address this in Study 3, I assess whether and when children differentiate between experts (those who know much but not everything about a certain domain) and an omniscient being (someone who

knows everything about all domains). Prior research indicates that preschoolers appreciate that experts hold more information than others about specific domains—for example, doctors know more than mechanics about health (Lutz & Keil, 2002). So far, no research has examined when children begin to understand that all-knowing agents know even more than experts about their own domains. With Study 3, I also examine what other cognitive capacities might underpin children’s developing understanding of omniscience.

The Force of Socio-cultural Input on Developing Concepts of Extraordinary Minds

Though anthropological and psychological literature contains accounts of why adults may create gods (e.g., to account for natural phenomena), young children may not spontaneously *generate* ideas of beings with extraordinary mental or exceptional perceptual abilities. Indeed, young children in particular tend to invoke ordinary physical, psychological, and biological explanations to account for phenomena (Bering & Parker, 2006; Hickling & Wellman, 2001; Johnson & Harris, 1994); and so young children likely do not spontaneously contemplate that some extraordinary agent is responsible for phenomena that they commonly experience. It is not until middle childhood when children begin to contemplate that an extraordinary agent was responsible for the origins of humans and animals (Evans, 2000b, 2001). Rather, young children likely initially acquire much of their ideas about beings with extraordinary capacities via cultural input—through conversations with others, religious teachings, movies, and books (Boyer, 2001). Indeed, much of the information that young children hold—ranging from the ordinary to the extraordinary—is acquired via the ‘testimony’ that others provide (Gelman, 2009; Harris, 2007; Harris & Koenig, 2006). This input may be provided

formally—for example, in religious classes—or informally, during conversation with friends or conversations with parents.

In the case of ToM development, children’s daily communicative interactions with others about their own and others’ mental experiences is associated with (and is thought to be predictive of) children’s developing understanding of ordinary human minds (for reviews, see Astington, 2005; Carpendale & Lewis, 2004). In particular, interactions with others who possess a more sophisticated ToM may facilitate children’s own ToM development. For example, Ruffman and colleagues (1998) found that children with older siblings, but not those with younger siblings, performed better on false-belief tasks. Other research demonstrates that parents’ use of mental-state language—references to their own and others’ psychological and emotional states—predicts children reaching certain ToM milestones at earlier ages (Carpendale & Lewis, 2004). Thus, it appears that social interaction facilitates an understanding of human minds. But what facilitates children’s understanding of extraordinary, non-human minds? Although children do not have opportunities to interact directly with beings that possess extraordinary mental capacities, they can acquire information about these agents second-hand, via their parents, in school, and through various media. Thus, in the current studies, I examine how children’s everyday exposure to media and activities involving extraordinary agents (namely God) facilitates their understanding of extraordinary minds. In particular, Studies 1 and 2 include a comparison of children who are secularly- schooled versus those who are religiously-schooled, as well as data on children’s knowledge of God. Study 3 includes parent reports of children’s religious participation and exposure to media about God.

However, children cannot just learn any type of information at any point in conceptual development; the new information must fit within their existing conceptual architecture or must itself spur conceptual restructuring (Gelman & Kalish, 2006; Wellman & Gelman, 1998). Indeed, other studies on early social-cognitive development demonstrate that socio-cultural input fosters conceptual change only among children at certain points in conceptual development or within certain age-ranges (e.g., Bamford & Lagattuta, 2010; Ruffman et al., 1998). Thus, in the current studies, I examine the relative influence of cultural input about extraordinary minds for children who are at different points in ToM development.

Specific Research Questions

Study 1: Children's Understanding of Ordinary and Extraordinary Minds

- 1) Which abilities (if any) do children attribute to agents when they fail traditional ToM tasks about ordinary human minds?
- 2) Do children initially treat all minds as human-like and fallible or as God-like and infallible?
- 3) When do children begin to conceptualize exceptional perceptual abilities?
- 4) When do children begin to conceptualize extraordinary mental abilities?

Study 2: Socio-cultural Input and Children's Developing Understanding of Extraordinary Minds

- 5) How does exposure to ideas about a being with extraordinary mental capacities (the Judeo-Christian God) influence children's initial understanding of that being's mind?

- 6) Does culturally-provided information about God's mind help children interpret the mind of a novel extraordinary agent?

Study 3: Approaching an Understanding of Omniscience from the Preschool Years to Early Adulthood

- 7) When and how do children understand the immense breadth of an all-knowing being's knowledge? What types of knowledge do children attribute to such beings at different points in development?
- 8) When and how do children understand the depth of an all-knowing being's knowledge? In particular, when do children understand that an omniscient being holds more domain-specific knowledge than experts?
- 9) Do children believe that all-knowing beings can really exist?
- 10) What other cognitive competencies support developing concepts of omniscience?
- 11) How and when is children's understanding of omniscience influenced by socio-cultural input about omniscient beings, like the Judeo-Christian God?

I address these questions in a multiple-manuscripts dissertation, including three studies that progressively build upon one another. Study 1 was designed to resolve prior discrepancies in the literature by examining the initial development of an understanding of extraordinary mental capacities during the preschool years. Study 1 is published as Lane, Wellman, and Evans (2010). Study 2 examines the influence of socio-cultural input on preschoolers' developing understanding of extraordinary minds by using the same methods as those from Study 1 with a sample of religiously-schooled preschoolers, comparing developmental trends between the two studies, and examining relations

between children's knowledge of God and their understanding of extraordinary minds across both samples. Study 2 has been accepted for publication as Lane, Wellman, and Evans (in press). Study 3 uses a different set of tasks to examine how an understanding of omniscience—all-knowingness—emerges from the preschool years through early adulthood. With Study 3, I also consider the roles of socio-cultural input and other cognitive competencies in supporting a developing understanding of omniscience.

CHAPTER II

Study 1: Children's Understanding of Ordinary and Extraordinary Minds¹

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 non-human 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.

¹ Study 1 is published as Lane, Wellman, and Evans (2010).

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 will 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 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 non-human 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 (1969/1929) 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 non-human beings, such as God, as human-like (Barrett & Keil, 1996; Gray, Gray, & Wegner, 2007). Indeed, although formal religious doctrine may attribute radically non-human, 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; Boyer, 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 et al., 2001; Barrett & Richert, 2003) 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 and colleagues (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 non-human) 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 and colleagues (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 non-human agents for these social-cognitive tasks.

A second empirical issue concerns the replicability of Barrett and colleagues' (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 non-human 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 a false-belief task and knowledge-ignorance task 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 non-human 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 Appendix A). 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. Children were densely sampled in a critical age range (50 to 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 Appendix A) using two tasks: one a

contents false-belief task (Perner, Leekam, & Wimmer, 1987), the other a knowledge-ignorance task (similar to that used by Barrett and colleagues, 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 five-by-seven-inch 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 Appendix A) 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 two 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 Appendix A), 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 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 the 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, $\chi^2(1, N = 56) = 0.30, ns$. 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, $\chi^2(1, N = 56) = 0.08, ns$. 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 1-1). 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 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 1-1 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: (1) with increasing age, children more often attributed false-beliefs to mom and the girl, (2) children in all three age-groups ascribed correct beliefs to Heroman, and (3) 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. Here, parametric statistics are presented for children's judgments, though non-parametric statistics confirm the results. An initial repeated-measures 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 ($F(4, 212) = 10.60, p < .001$), 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 of 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

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 1-2, and a residual Uncodable category (e.g., "I 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 inter-rater 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 1-3 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 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 the 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 type of box (e.g., “It’s a crayon box”). Similarly, of the 11 children who attributed a false-belief to God, nine (82%) cited the appearance of the box or 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 of the 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 1-4 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 four 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 1-2 depicts the focal data: the percentage of children who attributed ignorance to each agent, per age group. Three trends are noticeable in this graph: (1) with increasing age, children more often attributed ignorance to mom and the girl, with a later leveling-off, (2) children in all three age-groups attributed correct knowledge to Heroman and the cat, a tendency that was particularly pronounced in the oldest age-group, and (3) 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 ($ts(30) > 2.09$, $ps < .05$). 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, $ts(19) > 2.99$, $ps < .01$. 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 $ts(23) > 2.77$, $ps \leq .01$, 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 1-2). Twenty-percent of the justifications were coded by two coders (one unaware of the hypotheses and aims of the study) to assess inter-rater 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 children were told

nothing). Table 1-3 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 one 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 one provided a justification that suggested he appreciated Mr. Smart's extraordinary mind ("He knows everything"), and only one 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 of 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, four (29%) justified their responses by citing the appearance of the box (e.g., "It's dark"), and seven (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, three (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"), one 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, while 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, non-human 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, non-anthropomorphic terms. The alternative *preparedness* perspective proposes that very young children begin life well-equipped to understand that certain agents possess non-human 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 these 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 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 my 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 and colleagues (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 non-religious 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, the finding of specific “anthropomorphic” developmental periods (using tasks similar to those used by Barrett and colleagues, 2001) was a product of careful age sampling and precise age-related analyses of the data. Suppose instead we reexamine my data after removing participants to correct for the dense sampling in the middle age-range, and simply divide the remaining children into three arbitrary age-groups. Then only two age-graded linear trends emerge: (1) an increasing tendency to attribute fallible capacities to the girl and mom, and (2) a constant trend to attribute “infallible” capacities to God, Mr. Smart and Heroman. That is, with less precise sampling and age-grouping, my 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 1-1 and 1-2, such analyses would actually mask three different trends: (1) an increasing

linear trend to attribute fallible mental states to the girl and mom, (2) an apparently constant trend to attribute correct mental states to the cat and Heroman, and (3) 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 and colleagues (2005), and suggest that their data, too, may have emerged from samples and groupings that were able, like my 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 and colleagues' (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). Two techniques were used to obtain this additional, needed, information: (1) asking children about the knowledge and beliefs of agents with contrasting mental and perceptual capacities, and (2) 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, children were not told 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 children were provided no background information. Perhaps, in comparison with religiously trained children, the children in the current 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, children were asked 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 the same trends were found for God as for Mr. Smart, an agent about whom children definitely had relevant background information. However, we could not comprehensively examine the influence of religious exposure on children’s developing concepts of extraordinary minds, as 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 that an agent truly

knows *everything*—the nature of all past and future events, all scientific facts, everyone’s unspoken intentions and dreams, and so on. Rather, the oldest children likely understood God’s and Mr. Smart’s powers in a much less counterintuitive 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, non-human 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 five, 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.

CHAPTER III

Study 2: Socio-cultural Input Facilitates Children’s Developing Understanding of Extraordinary Minds²

During the preschool years, children’s understanding of the capacities and limitations of others’ minds—their theory-of-mind—undergoes rapid change (Harris, 2006; Wellman & Liu, 2004). Two-year-olds appreciate that people hold desires, and that different people may desire different things (Repacholi & Gopnik, 1997); and 3-year-olds additionally understand that people have thoughts and beliefs—mental representations of stimuli (e.g., objects, people) even in the physical absence of those stimuli (Wellman & Estes, 1986). Shortly thereafter, children begin to appreciate certain limitations of the mind. For example, older 3-year-olds appreciate that people can be ignorant about something if they have not perceived it (Pratt & Bryant, 1990). Most 5-year-olds additionally understand that people can hold false beliefs about the world based on inaccurate or outdated information (Perner, Leekam, & Wimmer, 1987), and soon thereafter children begin to appreciate that individuals have limited access to others’ private beliefs (Miller, 2009). But children (and adults) are not confronted exclusively by ordinary human agents; people entertain beliefs about agents who possess extraordinary capacities that are distinctly non-human. For example, television shows and movies abound with characters who possess exceptional perceptual capacities (e.g., x-ray vision), and many of the world’s religions espouse beings who possess extraordinary mental

² Study 2 has been accepted for publication as Lane, Wellman, and Evans (in press).

capacities (e.g., omniscience) (Campbell, 1993; Pickover, 2001). How do people come to understand the less constrained minds of these agents? In this paper we investigate the effects of socio-cultural input and theory-of-mind (ToM) on children's developing understanding of extraordinary minds.

In addition to providing a framework for how other people think and behave, a theory-of-mind can facilitate the representation of many sorts of minds, including the minds of non-human and super-human beings (Boyer, 1996; Epley, Waytz, & Cacioppo, 2007; Evans & Wellman, 2006; Shtulman, 2008). Concepts of extraordinary perceptual and cognitive abilities begin to emerge during the preschool years. But there is disagreement as to when and how children differentiate between the minds of ordinary humans and the minds of extraordinary beings. Primarily, two theories have been proposed to account for young children's understanding of extraordinary minds. The first is an *anthropomorphism* hypothesis (Boyer, 1996; Piaget, 1969), which states that children initially attribute to all agents the same psychological limits that they attribute to ordinary humans, and only later come to differentiate ordinary and extraordinary minds. Thus, for example, when children begin to appreciate that ordinary people can be ignorant or can hold false beliefs, they attribute the same cognitive limitation to all beings, ordinary and extraordinary. Before that time, children fail to understand the distinction between (potentially fallible) belief states and reality, so if required to judge beliefs they merely report states of reality for human and non-human agents. Several studies lend support to this theory (e.g., Giménez-Dasí, Guerrero, & Harris, 2005). Using a knowledge-ignorance task, Makris and Pnevmatikos (2007) found that 3- and 4-year-olds reported that both a girl and God would be ignorant about the contents of a closed

box without looking inside. Only children age five and older differentiated between the girl's ignorance and God's *correct* knowledge of the box's contents.

However, other studies provide evidence that appears to counter the anthropomorphism hypothesis. Barrett and colleagues (e.g., Barrett et al., 2001; Knight, Sousa, Barrett, & Atran, 2004), for example, administered false-belief and knowledge-access tasks to 3- to 7-year-olds, and found that the youngest children attributed 'infallible' mental capacities (i.e., correct knowledge and correct beliefs) to all agents tested, including humans and God; and older children who attributed ignorance and false beliefs to humans (typically those 5-years and older) continued to attribute correct mental capacities to God. Barrett and colleagues conclude that these results support an alternative *preparedness hypothesis* (Barrett & Richert, 2003), whereby children's early social-cognitive biases (e.g., not attributing false beliefs to agents) actually support the understanding of extraordinary mental abilities. That is, before children understand mental limitations, (e.g., ignorance, error, or false beliefs), they do not merely use reality to attribute agents' mental states (per the anthropomorphism hypothesis), rather they believe that agents are all-knowing. Accordingly, when children begin to attribute a particular mental fallibility (e.g., false beliefs) to ordinary humans, they can simply continue to attribute infallible mental capacities and states to God.

These research findings apparently conflict and are thus difficult to integrate theoretically. Critically, most extant studies lack data that are key to testing the opposing hypotheses—namely, data on the specific types of capacities children are actually attributing to agents. Further, the prior studies typically group children in large age-groups that may mask nuanced developmental trajectories. To address these issues, Lane,

Wellman, and Evans (2010) asked children from secular schools to make judgments and reason about the knowledge and beliefs of agents with contrasting perceptual and mental abilities: ordinary humans; Heroman, who “can see right through things”; Mr. Smart, who “knows everything”; a cat with night vision; and a religious deity (God). Critical to sufficiently testing the preparedness and anthropomorphism hypotheses, they densely sampled children at an age when children were beginning to attribute ignorance and false beliefs to ordinary humans. Results indicated that the youngest children’s (3-year-olds’) attribution of correct knowledge and beliefs to all agents largely reflected a reality bias—when justifying their decisions, 3-year-olds referred to reality (specifically the box’s current contents); they rarely mentioned the agents’ mental capacities or constraints. Moreover, somewhat older children (essentially 4-year-olds) who were beginning to understand the mental limitations of ordinary agents (ignorance and fallible beliefs), attributed those same limitations to the minds of Mr. Smart and God. Only the oldest children (5-years and older) differentiated between the fallible mental capacities (and resulting knowledge and beliefs) of humans and the less constrained mental capacities and states of God and Mr. Smart. Intriguingly, the 4-year-olds did appreciate that some agents’ exceptional *perceptual* abilities (e.g., Heroman’s x-ray vision) could lead to accurate knowledge and beliefs, but they did not appreciate extraordinary mental abilities. Overall, these findings present clear evidence in support of the anthropomorphism hypothesis, but also suggest that children come to appreciate some exceptional perceptual capacities (e.g., x-ray vision) before they appreciate extraordinary mental capacities (e.g., infallible beliefs).

One reason children may have an early appreciation of exceptional perceptual capacities is because perceptual capacities are observably more or less restricted across humans and animals—some people see well without glasses, others need them, dogs can hear silent dog whistles, bats have echolocation that allows them to navigate in the dark. In addition, children’s early grasp of exceptional perceptual abilities may reflect exposure to “testimony,” and media in which characters possess special abilities (e.g., bat’s echolocation, Superman’s x-ray vision). Indeed, children may hear not only about exceptional perceptual abilities but also about extraordinary mental abilities through various forms of informal and formal socio-cultural input (Bergstrom, Moehlmann, & Boyer, 2006; Harris & Koenig, 2006)—including broadly, parent-child discourse, oral and printed stories, movies, and formal or informal exposure to religious doctrine. Importantly, socio-cultural input of these various forms can have powerful effects on children’s conceptual development (Shweder et al., 2006), even if that information is not provided in an intentionally didactic manner (Atran & Sperber, 1991). For example, a large body of research demonstrates predictive relations between everyday socio-cultural input (e.g., parent-child discourse about mental states) and children’s developing understanding of ordinary human minds (for a review, see Carpendale & Lewis, 2004). Further, it is clear that socio-cultural input affects older children’s judgments of, for example, God’s extraordinary ability to create the living world (Evans, 2001). However, surprisingly little is known about the effects of such input, and focally exposure to religious ideas, on children’s developing concepts of extraordinary minds. It now seems unlikely that young children are cognitively *prepared* to understand extraordinary mental capacities, in that very young children evidence a reality bias, rather than an

understanding of extraordinary mental capacities (Lane et al., 2010). Nonetheless, once children do begin to consider the mental capacities of various agents, exposure to certain religious doctrine may *facilitate* the acquisition and application of concepts of extraordinary mental capacities. In particular, children who are heavily exposed to ideas about agents with extraordinary cognitive abilities (e.g., doctrine about God's omniscience) may more easily resist attributing cognitive limitations (e.g., false beliefs) to such agents.

Many of the studies mentioned have included children from religious communities but, again, offer unclear or conflicting results. Makris and Pnevmatikos (2007) offer evidence in favor of the anthropomorphism hypothesis in a sample of Greek Orthodox children. Further, in a sample of Spanish children, Giménez-Dasí and colleagues (2005) found that only after age five did children attribute extraordinary abilities of God rather than the fallible mental abilities representative of humans; and this was true for religiously-schooled as well as secularly-schooled children. But Barrett and colleagues arguably found support for the preparedness hypothesis in a sample of Christian children from the United States (Barrett et al., 2001) and in a sample of Yukatek Mayan children (Knight et al., 2004).

To understand how these seemingly conflicting results may contribute to a unified theory of children's understanding of extraordinary minds, in the current study we addressed the interplay between socio-cultural, religious input and children's developing concepts of extraordinary minds in three ways: (1) we used the methods employed by Lane et al. (2010) with a sample of children who attended religious schools and who were knowledgeable about God, (2) we directly compared the religiously-schooled children to

the secularly-schooled children from Lane et al., (2010), (3) across both samples, we examined relations between children’s knowledge of God and their understanding of extraordinary minds. To capture the potentially nuanced developmental trajectory of children’s appreciation for extraordinary minds, we followed Lane and colleagues (2010) by densely sampling children in an age-range when they were beginning to attribute particular mental fallibilities (ignorance and false beliefs) to ordinary humans, and asked children about the mental capacities of agents with contrasting abilities. These agents included ordinary humans, agents with exceptional perceptual capacities (a cat with night vision, and a superhero with x-ray vision), and agents with extraordinary mental capacities (Mr. Smart—an agent who “knows everything,” and God). We also systematically asked children to provide justifications for their decisions.

In advance, we can consider three possibilities. First, we might find results for religiously-schooled children very similar to those found by Lane and colleagues (2010), who studied children from secular schools. In particular, when these religiously-exposed children begin to appreciate a particular limitation of human minds (e.g., ignorance or false beliefs) they could, like secularly-schooled children, initially attribute that same limitation to agents with extraordinary mental capacities (focally, agents purported to be all-knowing). This would suggest that exposure to information about extraordinary minds does not affect young children’s initial understanding of extraordinary mental capacities.

On the other hand, socio-cultural input about extraordinary minds might facilitate an early ability to understand extraordinary mental capacities. Facilitation of children’s understanding of extraordinary minds due to early religious exposure could manifest in either of two ways in the current study. One straightforward possibility is that young

children who are knowledgeable about God will resist attributing ignorance or false beliefs to God at any point, even as they begin to attribute such mental fallibilities to ordinary humans. However, the effects of religious exposure and knowledge might be less straightforward and more subtle. For example, religiously-exposed children may hear and accept information about God's extraordinary capacities, but those capacities may not loom large in their everyday thinking about God. Thus, a third possibility is that the influence of religious exposure may surface only when such children are explicitly informed and reminded about some agent's extraordinary abilities. Indeed, while even adults believers tend to think of God as subject to many human-like psychological constraints, they are less likely to do so if first asked questions (and so reminded) about the nature of God's powers (Barrett & Keil, 1996).

Children's open-ended justifications for the ToM tasks could also shed light on the nature and timing of any facilitation due to religious exposure. For example, possible facilitation effects could potentially occur very early, even before children begin to appreciate limits of ordinary minds. In this case, very young religiously-exposed children should mention agents' special mental abilities (rather than merely reference reality) in their justifications. Alternatively, children may only begin to mention extraordinary capacities after they appreciate certain ordinary limits of human minds (e.g., false-beliefs or ignorance).

Method

Participants

Sixty-four children participated, all of whom attended religious Protestant Christian preschools; they were primarily of European-American descent and middle-

class socioeconomic status. We densely sampled in an age-range (54 to 59 months) in which, pilot testing showed, children were particularly likely to begin attributing ignorance or false beliefs to ordinary humans. The data from three children who were notably distracted were excluded, leaving 61 children (27 males) in the final sample, ranging in age from 37.87 to 76.53 months (M age = 56.92 months).

Children were recruited from Christian schools (all of which mentioned God and/or Christ in their mission statements); these institutions provide a pool of participants who are typically exposed to religion, at least at school. School affiliation is the most commonly-used method employed in prior research to recruit religiously-exposed children (e.g., Bering, Hernández Blasi, & Bjorklund, 2005; Giménez-Dasí et al., 2005; Richert & Barrett, 2005). However, because parents undoubtedly vary in their reasons for having their children attend religious schools, we sought additional information as to children's religious exposure and knowledge. In particular, we asked children about God at several points in our procedures. From these data (see Results) we found that 87% were familiar with God, and that 79% were able to provide specific details about God (e.g., "God made us"; "God knows everything"). Thus, our sample was not only religiously-exposed; children remembered key details about God. To gather additional information on children's religious exposure, we distributed a follow-up questionnaire to all of the children's parents. Thirty-eight parents (parents of 62% of the children) returned the questionnaire. Parallel to the proportion of children who evidenced familiarity with the concept of God, 84% of these parents reported that their children attend a place of worship; most on a weekly basis.

Procedure

Children were interviewed individually at school, using two tasks identical to those employed by Lane and colleagues (2010): a contents false-belief task (Perner et al., 1987), and a knowledge-ignorance task similar to that used by Barrett and colleagues (2001). Half of the children received the knowledge-ignorance task first; the others received the false-belief task first. Children were introduced to each agent (displayed on a card) upon their first exposure to that agent (for images of the agents and details on how each agent was introduced, see Appendix). For each task, children were presented the girl first; the remaining agents were presented in random order (except Mom was never presented following the girl).

Measures

False-belief understanding. Children were shown a crayon box and paper bag. The interviewer asked children what they thought was inside the crayon box, and then opened both containers to reveal that the box held marbles and the paper bag held crayons. Both containers were then closed and the interviewer checked if children remembered the contents of both containers; corrective feedback was offered when necessary, but was rarely required. Then, for each of five agents, children were asked: “__ has never been in the room with these things before. If we show __ this box, all closed up, [pictured agent approaches crayon box] what will __ think is inside here?” Children were asked this question with regard to a girl, their mother, Mr. Smart (a man who, children were instructed, “knows everything”), Heroman (a superhero with x-ray vision), and God (no information was given about God). Importantly, the example that we provided to children in Mr. Smart’s introduction (his knowing the contents of a box

without looking inside) is directly applicable to our social-cognitive tasks, for which children decide whether agents know the contents of containers. To assess the effects of anthropomorphic cues on children's concepts of God, half of the sample was not shown a picture representing God and were not told that God had "never been in the room;" they were just asked "What will God think is inside here?" To assess children's understanding of Mr. Smart's all-knowing abilities (without reliance on visual abilities), children were asked what Mr. Smart would think is in the box if he was far from the box facing in the opposite direction. For each agent, children earned a score of 0 if they ascribed a correct belief or 1 if they ascribed a false belief. Following each judgment, the interviewer prompted children to justify their answer by asking, "Why will ___ think ___ are inside?"

Knowledge-ignorance understanding. Children were shown two boxes that each had a slit, allowing visual access. Above the first box, a lamp was turned on, illuminating the inside of the box and revealing a red plastic frog inside. Above the second box, a lamp was turned off, and that box appeared empty. Children looked into each box and reported what they saw. After children affirmed that the lit box contained a frog and that they could see nothing in the unlit box, the experimenter turned on the lamp above the previously unlit box, revealing another red frog inside. That 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]." The interviewer then checked if children remembered the contents of both boxes; corrective feedback was offered when needed, but this was rarely required. Children were then asked the following for each of six agents 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. Children were asked this question for each of six different agents: a girl, their mom, Mr. Smart (a man who “knows everything”), Heroman (a superhero with x-ray vision) and God (about whom children were told nothing). Because this knowledge-ignorance task involves specifically children’s understand that darkness limits visual access to information, we added another agent with perceptual abilities that were directly applicable to this task—a cat that can see in the dark (see also Barrett et al., 2001; Lane et al., 2010). Again, half of the sample received no picture of God and were not told that God had “never been in this room;” they were only asked “What will God think is inside here; a frog or nothing?” To emphasize Mr. Smart’s reliance on mental and not visual abilities, children were asked what Mr. Smart would think is in the box if he was far from the box, 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 answer by asking, “Why will __ think __ is inside?” Children’s understanding of ignorance can be measured with a variety of tasks. We chose this task because it parallels that used by Barrett and colleagues (2001) and is identical to the one used by Lane et al. (2010), thus allowing a direct comparison with their findings. As is typical with knowledge-ignorance tasks (Wellman & Liu, 2004), Lane et al. (2010) found that children pass this task earlier than the false-belief task.

Knowledge of God. To obtain further information about children’s knowledge of God, following the theory-of-mind tasks, the interviewer told children, “Tell me about God.” If children could not provide any details initially, they were prompted, “Tell me

anything you know about God.” If children still provided no information, children were asked “Have you ever heard of God?”

Coding. The reasoning children used to justify their knowledge-ignorance and false-belief judgments were coded into 10 focal categories (see Table 2-1) and an additional “uninformative” category. To assess inter-rater reliability, 25% of the justifications were coded by two coders (one blind to all hypotheses of the study); all κ s \geq .88.

Children’s acquaintance with information about God was assessed using their justifications for God’s knowledge and beliefs for the theory-of-mind tasks combined with children’s responses to the final open-ended questions about God. *Knowledge of God* was coded as an ordinal variable with higher values representing greater knowledge of God, especially God’s extraordinary powers: (0) Child does not report knowing about God, (1) child has heard of God but cannot provide details, (2) child provides some details about God (e.g., location, physical status, role, relevance in prayer, connection with Jesus, connection with Heaven; mentions that God is “loving”, “not a person”, “a special person”), (3) child mentions exceptional abilities that are not perceptual or mental (e.g., role in creation, omnipresence, "God has powers"), or (4) child specifically mentions extraordinary perceptual or mental abilities. Similar measures (aggregating across multiple responses) have been used effectively in other studies investigating relations between children’s religious knowledge and conceptual development (e.g., Bamford & Lagattuta, 2010). Inter-coder agreement was 96.7% for the current *Knowledge of God* measure.

Results

In preliminary analyses, we assessed whether the presentation of the image representing God and language suggesting God's physical presence affected children's attribution of anthropomorphic, fallible mental abilities to God. For the false-belief task, 27% of children who were presented the image and language, and 16% of those children who neither saw the image nor heard the language, attributed to God a false belief, $\chi^2(1, N = 61) = 1.01, ns$. For the knowledge-ignorance task, 47% of children who were presented the image and language, and 19% who neither saw the image nor heard the language, attributed ignorance to God, $\chi^2(1, N = 61) = 5.16, p = .023$. Because this one effect of image did not vary between age groups—i.e., in a 3 (age group) X 2 (image+language vs. no-image+language) ANOVA there was no interaction between age and image, $F(2,55) = .35, ns, \eta_p^2 = .01$ —and because of modest sample sizes, we combined both groups of children in our main analyses.

In the following analyses, “correct knowledge” and “correct beliefs” refer to judgments that an agent knows what is actually in the boxes (for the false-belief task, marbles; for the knowledge-ignorance task, a frog). “Ignorance” and “false beliefs” refer to judgments that an agent is mistaken about the contents of the boxes (for the knowledge-ignorance task, that the agent thinks nothing is inside; for the false-belief task, that the agent thinks crayons are inside). Initial analyses assessed whether some children concurrently attributed human-like, fallible mental states to normal humans *and* to extraordinary beings, as expected under an anthropomorphism hypothesis. Indeed, many children attributed ignorance or false beliefs to each of the special agents—God, Mr. Smart, and Heroman—and those who did so also attributed false beliefs and ignorance to

the girl and mom at levels above chance—God: $\chi^2s(1) > 9.30$, $ps < .01$; Mr. Smart: $\chi^2s(1) > 9.30$, $ps < .01$; Heroman: $\chi^2s(1) > 3.50$, $ps < .06$. Thus, children consistently attributed limited mental capacities to all agents.

Of focal interest was whether a pattern of attributing human-like capacities to “special” agents would be common when children began to understand that humans may hold fallible mental states. Thus, initially, we examined children’s judgments to find developmental periods during which children first began attributing ignorance and false beliefs, respectively, to *ordinary humans* (their mom and the girl)—constitution of the ‘middle’ age groups for both tasks were based on these data, their judgments of ordinary humans. For the oldest age groups, we identified immediately subsequent periods during which children consistently attributed accurate knowledge or beliefs, respectively, to God. Because children often reach an understanding of ignorance and false beliefs at different points in ToM development (Wellman & Liu, 2004), it was important to create separate age groupings for the knowledge-ignorance task and false-belief task. Based upon this preliminary analysis, we divided children into three age-groups for the knowledge-ignorance task: 15 in the young group (37.9-51.0 months; $M = 45.6$), 20 in the middle group (51.2-59.6 months; $M = 55.9$), and 26 in the oldest group (59.7-76.5 months; $M = 64.2$); and for the false-belief task: 23 in the young group (37.9-55.4 months; $M = 48.3$), 12 in the middle group (55.6-59.7 months; $M = 57.7$), and 26 in the oldest group (59.7-76.5 months; $M = 64.2$). Thus, the middle age group for the knowledge-ignorance task is younger than the middle age group for the false-belief task (consistent with the meta-analysis of Wellman & Liu, 2004, as well as the findings of Lane et al., 2010).

Judgments

Figures 2-1 and 2-2 depict the percentage of children who attributed ignorance and false beliefs to each agent, by age group. An initial 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, cat, God), revealed significant main effects for age ($F(2, 58) = 9.66, p < .001, \eta_p^2 = .25$), and agent ($F(5, 54) = 10.43, p < .001, \eta_p^2 = .49$), and a significant interaction between age and agent, $F(10, 108) = 2.16, p < .05, \eta_p^2 = .17$. A separate ANOVA assessing children's attributions of false beliefs to the five agents (the cat was not included in the false-belief tasks) revealed similar effects of age ($F(2, 58) = 10.48, p < .001, \eta_p^2 = .27$), and agent ($F(4, 55) = 11.63, p < .001, \eta_p^2 = .46$), and a significant interaction between age and agent, $F(8, 110) = 3.23, p < .01, \eta_p^2 = .19$.

These interactions were explored in individual, repeated-measures ANOVAs for each age group, revealing that for the youngest children there were no differences between agents in children's attributions of ignorance ($F(5, 10) = 1.63, ns, \eta_p^2 = .20$) or false beliefs ($F(4, 19) = 1.26, ns, \eta_p^2 = .16$); young children attributed correct mental states to all agents at levels significantly greater than chance ($ts > 2.80, ps < .05$). Compared to the youngest children, those in the middle age-groups attributed ignorance more often to the girl, Mom, God, and Mr. Smart ($ts(33) > 2.03, ps < .05$, Cohen's $ds > .70$), and attributed false beliefs more often to the girl, Mom, and God ($ts(33) > 3.03, ps < .01$, Cohen's $ds > .95$). There were, however, no differences between the youngest and middle groups in attributions of correct mental states (i.e., the containers' actual contents) to the agents with exceptional *perception*—Heroman and the cat.

Within the middle age-groups, children selectively attributed ignorance ($F(5, 15) = 3.13, p < .05, \eta_p^2 = .51$) and false beliefs ($F(4, 8) = 3.29, p = .07, \eta_p^2 = .62$) to the different agents, as did children in the oldest age-groups for the knowledge-ignorance task ($F(5, 21) = 13.05, p < .001, \eta_p^2 = .76$) and the false-belief task, $F(4, 22) = 8.67, p < .001, \eta_p^2 = .61$. Specifically, children in the middle groups differentiated between the correct mental states of Heroman and the cat, and the fallible mental states of ordinary humans (mom and the girl), (for knowledge, $ts(19) > 2.90, ps < .01$, Cohen's $ds > 1.30$; for beliefs $ts(11) > 2.34, ps < .05$, Cohen's $ds > 1.40$). But children in the middle groups generally did not differentiate between the mental states of the ordinary humans (mom and the girl) and the mental states of God (to whom more than half of the children attributed ignorance or false-beliefs). Across multiple comparisons between God and the ordinary humans, just one—mom versus God for the false-belief task—was significant, $t(11) = 2.35, p < .05$, Cohen's $d = 1.41$. Only the oldest children (59 months and older) consistently differentiated between the correct knowledge and beliefs of God and the fallible knowledge and beliefs of mom and the girl, ($ts(25) > 4.04, ps < .001$, Cohen's $ds > 1.60$). In these respects, our data mimic those of Lane and colleagues (2010). In contrast to those data on children from non-religious schools, however, these religiously-schooled children in both middle and older groups attributed correct knowledge and beliefs to Mr. Smart, unlike mom and the girl, $ts > 2.66, ps < .05$, Cohen's $ds > 1.50$.

Parametric statistics were used in these focal analyses because ANOVAs are robust against violations of assumptions of normality for such data, and indeed may be preferable in repeated-measures designs using dichotomous data (Seeger & Gabrielsson, 1968). Non-parametric results further confirm our core findings. In these analyses, the

overall effects for agent remained significant for knowledge-ignorance judgments (Cochran's $Q = 78.61, p < .001$), and for false-belief judgments (Cochran's $Q = 60.15, p < .001$). Significant differences in judgments of ignorance and false-beliefs between the youngest and middle age-groups were replicated using Mann-Whitney U tests ($Us \leq 107.50, Zs \geq 1.95, ps \leq .05$). And within-age-group differences in children's attributions of ignorance or false-beliefs to pairs of agents (e.g., Mom versus Mr. Smart) were replicated using Wilcoxon Signed Ranks tests ($Zs \geq 2.00, ps < .05$).

Justifications

Children's justifications clarify the reasoning used in making their judgments. We focus on three contrasting "special" 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). Justifications for correct knowledge and beliefs are particularly revealing because they address which (if any) extraordinary capacities children attributed to these agents. Table 2-2 presents data on the primary ways in which children justified these three agents' correct knowledge and beliefs. The column with the mean ages depicts an age-graded trend in children's justifications: at younger ages, children cited reality (e.g., "There are marbles inside the box", "There is a frog") or provided uninformative answers (e.g., "Because", "I don't know"), at a somewhat older age children cited agents' *adequate* perceptual or mental capacities (e.g., "He saw it", "She knows"), and at the oldest ages children made specific reference to agents' exceptional perceptual or extraordinary mental abilities (e.g., "He can see through the box", "He's super smart").

Children could offer different types of justifications for each of the three ‘special’ agents, and so to assess whether these age trends were statistically significant, we split children into two independent groups for both of the tasks: (1) Those children who referred to reality or provided uninformative answers (and who never cited exceptional/extraordinary mental or perceptual capacities); and (2) Those children who cited exceptional/extraordinary mental or perceptual capacities (and who never cited reality or provided uninformative answers). For the false-belief task, 85% of the children fell into one of the two groups, and children who provided uninformative or reality-based justifications were significantly younger (M age = 50.02, SD = 7.39) than children who cited extraordinary mental or perceptual abilities (M age = 60.62, SD = 6.49), $t(50) = 5.49$, $p < .001$, Cohen’s $d = 1.52$. For the knowledge-ignorance task, 80% of the children fit into one of the two groups, and children who cited reality or provided uninformative answers were again significantly younger (M age = 51.51, SD = 8.97) than children who explicitly cited extraordinary mental or perceptual capacities (M age = 60.45, SD = 5.63), $t(47) = 4.30$, $p < .001$, Cohen’s $d = 1.19$. Thus, although the youngest and oldest groups of children both attributed ‘correct’ mental states to the special agents, they evidenced very different reasoning, with the youngest children displaying a reality bias and the oldest children demonstrating an appreciation for the agents’ particular mental and perceptual powers.

Religiously-Schooled Versus Secularly-Schooled Children

The tasks and procedures used here are identical to those used by Lane and colleagues (2010) for 56 children attending secular preschools (ages 40 to 73 months; M age = 54 months). Across both samples, 77 parents (66%) completed a questionnaire on

their children's religious exposure—38 parents (62%) for the current religiously-schooled sample, and 39 parents (70%) for Lane et al.'s secularly-schooled sample. Using a scale from 1 (Never) to 5 (Daily), those parents in the current religiously-schooled sample reported that their children were exposed to significantly more media (stories, movies, music, games) about God ($M = 3.29$, $SD = .93$) than did parents of secularly-schooled children from Lane et al. ($M = 1.99$, $SD = .96$), $t(75) = 6.07$, $p < .001$, Cohen's $d = 1.37$. Moreover, parents of the religiously-schooled children reported that their children more frequently attended a place of worship ($M = 3.45$, $SD = 1.03$) than the secularly-schooled children from Lane et al. ($M = 2.26$, $SD = 1.35$), $t(75) = 4.34$, $p < .001$, Cohen's $d = .99$.

These parental data help confirm that school attended (religious vs. secular) was a reliable proxy for children's overall exposure to concepts of God. Moreover, the identical procedures used in the two studies allow some informative comparisons based on religious exposure. Comparisons across all conditions for the two groups of children (religious vs. secularly schooled) would be problematic because the children came from different communities and the age ranges identified for the critical 'middle age' children are different for the religiously- and secularly-schooled groups. Nonetheless, several focal comparisons are possible. In particular, while trends and results are largely parallel in both studies for most agents, there are some key differences, especially for Mr. Smart. First, using the same age range for the middle group as that used by Lane and colleagues (2010) (for knowledge-ignorance: 49.5 to 54.5 months; for false-belief: 52.5 to 58.9 months), religiously-schooled children in this middle age-group attributed correct mental states (knowledge and beliefs of the containers' actual contents) to Mr. Smart (but not God) significantly above chance: $\chi^2(1, n = 9) = 5.44$, $p < .05$ for knowledge; $\chi^2(1,$

$n = 14$) = 7.14, $p < .01$ for beliefs; whereas similarly-aged secularly-schooled children attributed fallible mental states to Mr. Smart, just as they did for mom, the girl, and God. Further, religiously-schooled children in this age range were much more likely to attribute correct knowledge and beliefs to Mr. Smart (Mann-Whitney $U_s < 60.00$, $Z_s > 2.78$, $p_s < .01$) than were their secularly-schooled peers. They were also somewhat more likely to attribute correct knowledge and beliefs to God (Mann-Whitney $U_s < 77.00$, $Z_s > 1.97$, $p_s < .05$).

Beyond using school as a proxy for religious exposure, we also more directly gauged children's religious exposure by their scores on our *Knowledge of God* measure. These data, yielding a score of 0-4 summarizing children's knowledge of God, were available for every child in both studies ($n = 117$). On this *Knowledge of God* measure, religiously-schooled children in the current study scored significantly higher ($M = 2.56$, $SD = 1.38$) than secularly-schooled children in Lane et al. ($M = 1.88$, $SD = 1.67$), $t(115) = 2.41$, $p < .05$, Cohen's $d = .44$. Of the religiously-schooled children, 79% received scores greater than 1 (provided details about God), and 56% received scores of 3 or 4 (mentioned God's exceptional abilities). In contrast, only 59% of the secularly-schooled children from Lane et al. (2010) received a score of 1 or greater and only 37% received scores of 3 or 4.

Children's knowledge of God not only further validates the group differences in religious exposure, it provides an additional way to consider how exposure to religious instruction influenced children's responses on our tasks. Collapsing across data from both the religious and secular samples, we assessed the relation between children's knowledge of God and their attributions of ignorance and false beliefs to three of the 'special'

agents: God, Mr. Smart, and Heroman. For both tasks, Pearson correlations indicated that children's knowledge of God predicted their attributions of correct mental states to the three agents, but only among children who understood the constraints of human minds (i.e., who attributed ignorance or false beliefs, respectively, to both the girl and Mom). Thus, for children who attributed false beliefs to Mom and the girl, knowledge of God predicted attributions of *correct* beliefs to God ($r(55) = .50, p < .001$), to Mr. Smart ($r(55) = .35, p < .01$), and to Heroman, $r(55) = .45, p < .001$. Similarly, among children who attributed ignorance to Mom and the girl, knowledge of God predicted attributions of correct knowledge to God ($r(65) = .45, p < .001$), and Heroman ($r(65) = .24, p = .05$); for Mr. Smart the trend was in the expected direction, albeit non-significant, $r(65) = .20$.

We next assessed relations between children's knowledge of God and the justifications they offered when considering the mental states of the other two special agents, Heroman and Mr. Smart. For each of the five most often used categories—extraordinary mental abilities, exceptional perception, adequate abilities, reality-based reasoning, and uninformative reasoning—children were given a point if they used that justification for either Heroman or Mr. Smart on the false-belief task, and a point if they used that justification for either agent on the knowledge-ignorance task (scores for each of the five justification categories could range from 0 to 2). Controlling for age, children's knowledge of God predicted less use of uninformative justifications ($r(114) = -.19, p < .05$), marginally fewer references to adequate abilities ($r(114) = -.16, p = .09$), and focally, greater reference to exceptional perception ($r(114) = .24, p < .01$) as well as extraordinary mental abilities ($r(114) = .25, p < .01$). In sum, more sophisticated knowledge of God's abilities predicted greater reference to exceptional or extraordinary

capacities for other special agents, and this was not merely a function of other age-related developments.

Discussion

Human social cognition is characterized by an ability to consider the ordinary minds of fellow humans as well as the extraordinary minds of non-human and superhuman beings (Boyer, 1996). Several recent studies suggest that the route through which children come to appreciate such extraordinary minds is best described as anthropomorphic. Initially, very young children treat all minds the same way in that they fail to understand the distinction between (potentially fallible) mental states and reality. Thus, if required to judge others' knowledge or beliefs they merely report states of reality for ordinary humans and for extraordinary agents. Second, and critically, when children begin to appreciate certain limitations of human epistemic states (e.g., false beliefs) they attribute those same cognitive constraints to most other agents, including supernatural agents (Giménez-Dasí et al., 2005; Lane et al., 2010; Makris & Pnevmatikos, 2007). The current study revealed this overall pattern of results from children who were raised in specifically religious contexts and who were knowledgeable about God, using methods that help to resolve discrepancies in prior results. The detailed findings go beyond confirming an early childhood anthropomorphism, however, to shed light on ways in which socio-cultural input about agents with supernatural mental capacities (i.e., exposure to knowledge about God) influences an early appreciation for extraordinary mental abilities.

A strict anthropomorphism account would claim that young children think of God (and all other special agents) in terms of human capacities and do so throughout the

preschool years and well beyond (Piaget, 1969). Much recent data, including our own, contradict any such strict account by demonstrating that 4- and 5-year-olds often allow some agents certain non-human capacities, as is first apparent for exceptional *perceptual* capacities (our Heroman and cat, but see also Richert & Barrett, 2005). As we have noted, however, one key issue concerns children at transitional points when they are beginning to acknowledge particular limits of human mental capacities. Although they espouse preparedness rather than anthropomorphism, Richert and Barrett (2005) also adopt this view when they say that, if the anthropomorphism account is correct, then “when children understand that humans have limited perspectives, they will also attribute limited perspectives to God and other nonhumans... a 3-year-old’s apparently accurate representation of God will begin to disintegrate as he or she acquires a ‘theory of mind’” (p. 292). The current study, along with others (Giménez-Dasí et al., 2005; Lane et al., 2010; Makris & Pnevmatikos, 2007), lends support to just such an anthropomorphism hypothesis.

Our evidence from children’s justifications reveals that, much like secularly-schooled children (Lane et al., 2010), young religiously-schooled children’s failure on false-belief and knowledge-ignorance tasks reflects an early reality bias, not an appreciation for extraordinary mental abilities. That is, very young children simply reference conditions in the world, reality, to infer others’ mental states, without considering others’ mental limits (like false beliefs) or mental capacities (like omniscience). Further, the current data demonstrate that, much like children from secular schools, religiously-schooled children who are beginning to appreciate certain limitations of human minds (ignorance and false beliefs) typically also attribute those constraints to

agents whom they are raised to believe ‘know everything’—in this case, the Judeo-Christian God. We focus on God here, for the moment, because Barrett and colleagues in articulating their preparedness account claim that children should always “resist treating God like a human.” Further, they claim that it is “quite easy for young children to represent God as different from humans” (Richert & Barrett, 2005, pp. 292-293). On the contrary, with regard to God in particular, data from the current study provide compelling evidence that when children begin to understand the cognitive limitations of humans, they typically apply those same limitations to God, and this applies even to religiously-exposed children. Only later, at around age 5-years did religiously-exposed children reliably differentiate between humans’ fallible mental abilities and inaccurate mental states versus God’s less fallible abilities and states. These results suggest that, in their everyday reasoning, even children who are raised in religious settings often initially understand God’s mind as constrained and fallible, very similar to their understanding of ordinary human minds. Indeed, in their everyday reasoning, even adults who profess beliefs in God’s extraordinary capacities tend to think of God as being subject to ordinary, human-like perceptual and mental constraints (Barrett & Keil, 1996).

However, our results also speak to the important influence of socio-cultural input, as indexed by religious exposure, in children’s conceptual development and suggest that, with guidance, even quite young children can consider some agents’ minds as less fallible. Four-year-olds in this religiously-exposed sample, just as secularly-schooled children in the earlier study (Lane et al., 2010), attributed accurate knowledge and beliefs to agents with exceptional perceptual abilities (e.g., Heroman), and, moreover, specifically referred to special perceptual abilities when justifying why these agents hold

privileged information. As described earlier, this may be, in part, a product of children's exposure to media about certain agents' exceptional perception (e.g., Superman's x-ray vision) from a very early age.

More novel and intriguing, religiously-exposed children in this study as young as 4-years evidenced an early appreciation for extraordinary mental abilities in their responses to Mr. Smart, an agent whose mental prowess they were first primed and then reminded about (Mr. Smart "knows everything"). This contrasts with the secularly-schooled children studied by Lane and colleagues (2010) who received the same instructions and reminders about Mr. Smart. Thus, consistent exposure to ideas about the extraordinary mental and perceptual abilities of one agent—the Judeo-Christian God—may have facilitated children's understanding of Mr. Smart when children were specifically instructed and reminded he "knows everything." This occurred even though religious exposure had not yet resulted in children's spontaneous attribution of extraordinary mental capacities to God. Thus, at 4-years, an understanding that extraordinary agents can have extraordinary knowledge (know the contents of containers without perceiving those contents) had not yet reached a level of "intuitive fluency" (Shweder et al., 2006, p. 733). These data suggest that children's anthropomorphism strongly influenced their ability to apply the culturally/religiously-provided information about "God", but that their on-going religious instruction nonetheless facilitated their ability to apply information about extraordinary mental states when that information was directly and immediately provided. This could account for their relative sensitivity to information that we explicitly provided about Mr. Smart's extraordinary mind.

Notably, the difference between the religiously-schooled children in this study and the secularly-schooled children in a previous study (Lane et al., 2010) with respect to Mr. Smart (and even somewhat to God) was found for children in the middle age groups; that is, those children who were beginning to appreciate certain capacities and limitations of ordinary human minds. Indeed, among children who understood the fallible mental capacities of the girl and mom, children's knowledge of God predicted attributions of correct mental states to Heroman, Mr. Smart, and God. Thus, this period—when children are beginning to appreciate the limits of human minds—may also represent a period when children are particularly receptive to cultural input about extraordinary capacities that exceed those particular limits, and can begin to incorporate this information into their existing theory-of-mind.

In sum, the current study reveals that developing concepts of extraordinary perceptual and psychological abilities are a function of both children's conceptual architecture and the socio-cultural input that children receive; and that conceptual change is not a simple product of the two. Importantly, the impact of socio-cultural input on conceptual development varies depending upon children's existing conceptual structure (see also Evans, 2001). One way to describe the current results, therefore, is that socio-cultural input is assimilated only to the extent that children's current conceptual structure—in this case, children's theory-of-mind—is able to integrate that input. Taken together with the data from Lane et al. (2010), we provide evidence that, although children may not be *prepared* to understand extraordinary mental capacities, at a certain point in theory-of-mind development (at around 4-years in this population), socio-cultural input can *facilitate* an early appreciation for extraordinary minds. This would represent a

developmental version of Sperber’s reasoning about the “epidemiology of beliefs,” with a focus on how “previously internalized cultural representations are a key factor in one’s susceptibility to new representations” (Sperber, 1996, p. 84). Children’s developing understanding of ordinary minds makes them susceptible, at key junctures, to socio-culturally provided information about extraordinary minds.

A next step in understanding children’s concepts of extraordinary minds is to chart more specifically the intricate interplay between conceptual development and socio-cultural input over the preschool and early elementary school years. Two lines of research seem particularly important for this endeavor. First, although we provide evidence that, with cultural assistance, children as young as 4-years can begin to appreciate the extraordinary capacities of some agents (e.g., knowing the contents of containers without looking inside); children at this age are not evidencing a full-fledged understanding of anything like omniscience. Omniscience refers to an agent’s ability to know *everything*—not just the contents of boxes, but also facts about the past and present, an ability to foretell the future, an ability to read minds, and much more. Arguably children’s appreciation that some special agents can know contents of containers without seeing those contents marks the very beginning of a developing grasp of extraordinary mental abilities—the first of many steps involved in achieving an understanding of omniscience. Much as a developing understanding of ordinary minds proceeds through a series of developmental steps (Wellman & Liu, 2004), so might a developing understanding of extraordinary minds. Future research should address when and how children come to appreciate that certain extraordinary agents (such as the Judeo-Christian God) can possess these other types of knowledge and how the progressive understanding of

extraordinary mental capacities undergirds a remarkably counterintuitive understanding of total omniscience.

Second, as detailed in the current study and by Lane et al. (2010) some of these developmental transitions may last for only brief periods and are thus difficult to capture using cross-sectional data. Thus, a worthwhile next venture is to examine how these developments unfold longitudinally, using a microgenetic approach. Such work will shed further light on the precise development of supernatural concepts as children are beginning to confront the limits of the human mind.

CHAPTER IV

Study 3: Approaching an Understanding of Omniscience from the Preschool Years to Early Adulthood

By the late preschool years, children in many communities throughout the world—in Greece, Mexico, Spain, and the United States—can distinguish between the minds of ordinary humans and the minds of more extraordinary beings (e.g., Barrett, Richert, & Driesenga, 2001; Giménez-Dasí, Guerrero, & Harris, 2005; Knight, Sousa, Barrett, & Atran, 2008; Lane, Wellman, & Evans, 2010; Makris & Pnevmatikos, 2007; Richert & Barrett, 2005). For example, 5-year-olds understand that an ordinary person (e.g., their mother) who has not looked in a novel box will not know its contents, but that God will know the box’s contents. At this age, children can also articulate that God will know the box’s contents because he has a special mind, and children can even apply this understanding to a novel being who “knows everything” (Lane et al., 2010; Lane, Wellman, & Evans, in press). There is general consensus that data such as these demonstrate that children can understand some extraordinary mental capacities by the late preschool years. However, there is continued debate about the route through which children develop that understanding as well as the extent of children’s understanding at this age.

On the issue of how 5-year-olds reach an understanding of extraordinary mental capacities, there are two broad camps. Some theorists believe that very young children are *prepared* to understand all-knowingness or mental infallibility (e.g., Barrett &

Richert, 2003). This position was inspired by research which demonstrates that when younger children (3-year-olds) are aware of a certain state of reality—for example, the contents of the box described above—they typically over-attribute such knowledge to others, including God. Drawing upon this common finding, and the findings that 5-year-olds also attribute accurate knowledge to God (e.g., Barrett et al., 2001), Barrett and Richert surmise that, “on many properties, young children seem equipped with default assumptions that better match theological descriptions of God than adult conceptions of people. Three-year-olds assume beliefs and percepts are infallible. They assume greater access to background knowledge than humans actually have” (2003, p. 309). Others have made stronger claims. In a recent CNN.com interview, a Theology faculty member at Oxford University recently explained that “‘Children in particular [find] it very easy to think in religious ways,’ such as believing in God’s omniscience” (Greene, 2011).

Other theorists argue against this “preparedness” interpretation, and instead endorse a type of *anthropomorphism* hypothesis, which states that children typically think of the capacities of many agents, including extraordinary beings, in ordinary, human-like terms. This hypothesis is supported by studies showing that when 3-year-olds judge that God or other all-knowing beings are aware of the true contents of the box described above, they justify such judgments by citing reality (“That’s what’s in there”); they rarely mention those agents’ mental abilities at all—in other words, they rarely consider individuals’ capacities and constraints on these tasks. In contrast, 5-year-olds overwhelmingly explain that God will know the box’s contents because he has a special mind or because he has special vision (e.g., Lane et al., 2010; Study 1 in this dissertation). Thus, what 3-year-olds and 5-year-olds are doing on these tasks is quite

different. Moreover, several studies now demonstrate that 4-year-olds, who are just beginning to report that ordinary humans will *not* know the contents of the box, often report that God will be ignorant as well (e.g., Giménez-Dasí et al., 2005; Lane et al., 2010, in press; Makris & Pnevmatikos, 2007). Thus, when children first consider how an individual's mental capacities function in a particular situation, they often over-attribute ordinary limitations to extraordinary beings, even to God.

Given these data, it might be easy to conclude that by 5 years, children are demonstrating an understanding of omniscience—they attribute incorrect knowledge to ordinary humans (e.g., their mother) while simultaneously attributing accurate knowledge to God. While 5-year-olds' performance in these studies is impressive, I argue that it does not reflect an understanding of *omniscience*. Omniscience refers to one's ability to know *everything*; not just ordinary information about the here-and-now, but all facts about the past and present, an ability to foretell the future, an ability to read minds, and much more. An omniscient agent also knows more about a domain of knowledge than the world's greatest expert on that subject. However, most of these studies have only demonstrated that children attribute to extraordinary beings certain readily-accessible information about the here-and-now—for example, the contents of closed containers, or the appearance or smell of things that are placed far away. Moreover, in most of these paradigms, children themselves possess the knowledge. Perhaps children's appreciation of some special agents' access to such information marks the very beginning of a developing appreciation for extraordinary mental abilities—the first of many steps. Thus far, no data speak to children's ability to entertain increasingly counterintuitive concepts of extraordinary

minds, like an omniscient being's ability to predict the future, read minds, or outsmart experts.

In Study 3, I assess preschoolers', elementary-school children's, and adults' understanding of the breadth and depth of an all-knowing being's knowledge. By "breadth", I am referring to the *types* or domains of knowledge that someone possesses; here I focus on an all-knowing agent's knowledge of facts about the past, present, and future, as well as knowledge of others' personal information (for example, someone else's thoughts, preferences, and actions). These forms of knowledge were chosen because children's attribution of such knowledge to extraordinary beings may mark different points in a developing understanding of extraordinary minds. While younger preschoolers may grant an all-knowing agent knowledge about certain facts in the past and present—indeed on standard knowledge-ignorance and false-belief tasks, preschoolers clearly understand that ordinary people possess information about the past and present—they may resist the idea that an agent can possess knowledge of the future. Young children are also developing an understanding of the private nature of one's beliefs and desires. By 4 years, children understand that mental phenomena—such as desires, beliefs, knowledge, and dreams—are contained in one's brain or mind, and that other people do not have direct access to the contents of people's minds (for reviews, see Miller, 2009; Wellman & Johnson, 2008). Thus, young children, who are developing a firm understanding of the private nature of the mind, may be particularly unwilling to overturn their assumptions about the mind to accept that any agent has access to others' personal mental states.

I also assess participants' understanding of the *depth* of an all-knowing being's knowledge. By "depth", I am referring to the amount of knowledge that one possesses *within* a domain. To assess this understanding, I examine when children begin to appreciate that an omniscient agent's knowledge surpasses experts' knowledge within the experts' domains of expertise. To understand this, children must make the distinction between knowing a lot about a specific domain (i.e., being expert) and knowing *everything* there is to know about every domain (being omniscient). Children's understanding of expertise is well-researched, with prior studies indicating that preschool-age children appreciate that experts know more than others about specific domains—for example, doctors know more about health than do mechanics (Lutz & Keil, 2002). It is unclear just how deep young children consider experts' knowledge to be. If preschoolers conceptualize an expert as being all-knowing about a specific domain, they may be unwilling to accept that anyone can hold more information about a domain than an expert. Thus, addressing how children differentiate between experts and omniscient beings promises to address when children understand that experts' domain-specific knowledge is substantial but not necessarily complete. Even if young children understand that an expert is ignorant about certain domain-specific information, in order to understand omniscience, they must also conceptualize that another being can possess more domain-specific knowledge than an expert, even in the absence of deliberate training.

If, by the late preschool years, children fully understand omniscience, they should easily grasp the breadth and depth of an all-knowing agent's knowledge—such a being can predict the future, can read minds, knows more than experts about every domain, and

so on. However, much as a developing understanding of ordinary minds proceeds across a series of developmental milestones (Wellman & Liu, 2004), so may a developing understanding of extraordinary minds. As discussed, during early childhood, children are developing initial concepts of the nature and capacities of ordinary minds—for example, that the contents of the mind are private and that some types of people are more knowledgeable than others—and so may be particularly unwilling to override their newly-formed intuitions about the mind. In addition to examining when children can conceptualize these components of omniscience, I also ask whether children think that a being with these capacities can exist.

Another goal of the current studies is to identify contextual and cognitive factors that support children's developing understanding of omniscience. As demonstrated by Lane and colleagues (in press; Study 2 in this dissertation), children raised in contexts in which ideas about omniscient beings are more prominent—for example, children raised with the idea of a Judeo-Christian God—develop an initial understanding of extraordinary mental capacities somewhat earlier than children who are not as heavily exposed to such ideas. Moreover, Lane and colleagues (in press) demonstrated that children's knowledge of God predicts attributions of privileged knowledge to extraordinary beings, but only among children who have a robust representational theory of mind. In the current study, I examine how exposure to religious contexts and ideas about the Judeo-Christian God relates to children's developing understanding of omniscience, and I examine whether such relations vary by age.

An understanding of omniscience may also be contingent upon the development of other cognitive competencies that are not in place until later in childhood. For

example, it is not until age 8 that children begin to appreciate that numbers are unlimited—that the amount of numbers exceeds even extremely large finite quantities (Falk, 1994; Falk & Ben-Lavy, 1989). If a similar concept of ‘unlimited’ underlies children’s understanding of omniscience, it may not be until middle childhood when children appreciate that all-knowing agents’ knowledge surpasses even the extremely large amount of knowledge held by experts. However, as conceptual development proceeds at different rates and timings in different domains (Wellman & Gelman, 1998; Gelman & Kalish, 2006), these developments may be unrelated. Another capacity that may play an important role in children’s understanding of omniscience is their ability to imagine improbable phenomena. Preschoolers are particularly doubtful that improbable phenomena, which they have not personally seen, can actually occur (Shtulman & Carey, 2007); and this is equally true of children’s reasoning about biological, psychological, and physical phenomena (Shtulman, 2009). Because children do not interact with all-knowing beings, they may be especially skeptical that someone can actually be all-knowing. In the current studies, I examine how both children’s understanding of limitlessness and their ability to imagine the improbable relate to their understanding of omniscience, and how such relations vary across development.

These issues will be addressed in two studies. Study 3A examines a developing understanding of the breadth and depth of all-knowing beings’ knowledge in a small sample of preschoolers, elementary-school children, and adults. Study 3A also examines whether children (and adults) *believe* such beings can really exist. Study 3B addresses these same issues, but with a refined protocol designed to scaffold children’s understanding of extraordinary mental capacities and thus assesses the limits of

children's understanding at different points in development. Study 3B additionally examines the roles of socio-cultural input and other cognitive developments in facilitating an understanding of omniscience. Study 3B includes a larger sample, permitting more fine-grained analysis of the development of an understanding of extraordinary minds.

Study 3A

Study 3A is an initial investigation of the breadth and depth of knowledge that children and adults grant to a being that they are taught “knows everything about everything.” Study 3A also examines the extent to which children and adults believe that all-knowing beings can really exist.

Method

Participants

Participants included 21 preschoolers (ages 3 years, 8 months – 6 years) and 19 elementary-school children (6 years – 12 years, 8 months) who were attended schools or camp in southeastern Michigan. One 3-year-old was not fluent in English and one 4-year-old did not want to complete the interview, resulting in a preschool sample of 19.

Twenty-four adults (18 years – 21 years, 8 months) also participated, all of whom were recruited through the University's Introduction to Psychology Subject Pool. Participants were primarily White and of middle- to upper-middle-class socioeconomic status.

Procedure and Measures

Understanding experts' depth of knowledge. First, participants were presented four experts—a doctor, mechanic, chef, and pilot—on laminated cards and told what each expert does (for expert images and introductions, see Appendix B). For each of the four experts, participants were asked how much each expert knows about their respective

domain; for example, “How much does a doctor know about being healthy? Some things, lots of things, or everything?” Half of the participants received the options as ordered above, the other half were asked if the experts know “Everything, lots of things, or some things?” As a visual aid, participants were shown a graph with three vertical bars reflecting each of the three amounts; younger children often responded to the questions by pointing to the respective bars. For these questions, and for all questions that follow, if a participant responded “I don’t know” or did not offer an answer, he or she was encouraged to provide an answer (e.g., “You can answer however you like; there are no wrong answers”, the question was repeated, and, for closed-ended questions, response options were given).

Understanding domain-specific expertise. Following Lutz and Keil (2002), participants’ understanding of domain-specific expertise was assessed by asking them eight questions in which they compared the knowledge held by the different experts (e.g., “Who knows more about why you get a runny nose, a doctor or a mechanic?”; for the full pool of questions, see Appendix C). Participants could respond by naming or pointing to the expert.

Understanding an all-knowing beings’ breadth of knowledge. Participants were then introduced to Ms. Smart (for boys, Mr. Smart) a character who “knows everything about everything” (see Appendix D), and were asked six closed-ended questions concerning the types of knowledge that Ms. Smart possesses. These included three questions about whether Ms. Smart would know non-personal information about the past, present, and future, as well as three questions about whether Ms. Smart would know personal information—about the child’s preferences, thoughts, and life events (for

closed-ended questions, see Table 3-1). Open-ended data were also collected. For two closed-ended questions—whether Ms. Smart would know about the future and would know the child’s thoughts—if participants granted Ms. Smart knowledge, they were asked “How did she know?” and if participants denied Ms. Smart knowledge, they were asked, “Why not?”

Understanding an all-knowing being’s depth of knowledge. To understand omniscience, one must appreciate that an all-knowing being knows even more about a specific domain than an expert—an omniscient beings’ knowledge is so broad that it encapsulates all experts’ knowledge and then some. To examine participants understanding of the depth of Ms. Smart’s knowledge, across 16 questions, they compared the knowledge held by the experts and Ms. Smart (e.g., “Who knows more about why you get a runny nose, a doctor or Ms. Smart?”). Participants could respond by naming or pointing to the expert or Ms. Smart. Four questions were asked for each of the four experts, and experts were presented one at a time. To limit the extent to which the experts’ mere appearance (rather than their actual knowledge) affected participants’ responses, images of the experts and Ms. Smart were turned over before asking the questions. Eight of these questions referred to knowledge *outside of the experts’ domains*, and eight referred to knowledge *within the experts’ domains* (for the complete pool of questions, see Appendix C). For half of the participants, comparisons between Ms. Smart and each expert began with an item within the expert’s domain; half of the participants first received items that were outside of each expert’s domain.

Belief that someone can know everything. To gather more information on participants’ understanding of the capacities and constraints of the mind, participants

were asked several additional questions about their knowledge of beings with extraordinary mental abilities. These questions included, “Have you ever heard of anyone else who knows everything about everything?” and if so, “Who?”; and “Do you think someone can *really* know everything about everything?”

Coding. A coding system for all open-ended responses was developed through an iterative process. These included responses to open-ended questions concerning Ms. Smart’s breadth of knowledge, participants’ knowledge of anyone who knows everything about everything, the types of knowledge those individuals would possess, and whether someone can really know everything about everything. Lane and a research assistant developed a preliminary coding system, individually coded small subsamples of data, and compared coding. Coding discrepancies were discussed and the system was modified as needed to limit future discrepancies. To establish inter-rater reliability with the final coding system, data were categorized independently by Lane and the research assistant until a criterion of at least 85% inter-rater agreement was reached for each question, across 20% of the data (12 interviews). Remaining discrepancies were discussed by both coders and resolved. Once this criterion had been met, the remaining open-ended responses were coded by the research assistant.

Results

In the following, I first examine participants’ understanding of expertise—their understanding of the depth of experts’ knowledge as well as their understanding of the types of information contained within experts’ domains of expertise. Next, and focally, I assess participants’ understanding of the breadth of an all-knowing being’s knowledge (by asking about the types of knowledge that Ms. Smart possesses), as well as the depth

of an all-knowing being's knowledge (by having participants compare Ms. Smart's knowledge to that of the experts). Finally, I assess participants' beliefs about the existence of all-knowing beings.

Understanding Experts' Depth of Knowledge

If children believe that experts are all-knowing about their domain, then it would be impossible for anyone (even an omniscient being) to hold more domain-specific knowledge than an expert. Thus, it was first necessary to assess how much domain-specific knowledge children actually attribute to experts. Participants were asked how much each of four experts—a doctor, mechanic, pilot, and chef—knows about their respective domain. For example, they were asked, “How much does a doctor know about medicine? Some things, lots of things, or everything?”; with “some things” coded as 1, “lots of things” coded as 2, and “everything” coded as 3. Using this calculation, an initial one-way ANOVA indicated that attributions of knowledge to the experts did not vary by age group, $F(2, 59) = .37, ns$. However, there was a significant age difference in participants' (incorrectly) attributing knowledge of “everything” to the experts, $\chi^2(2) = 8.61, p < .05$. Preschoolers attributed knowledge of “everything” to the experts for 50% of their responses, compared to 39% for elementary school-children and only 24% for adults.

Participants were next asked to *compare* the knowledge held by the different experts; for example, “Who knows more about why you get a runny nose, a doctor or mechanic?” For this task, there were no age differences in correct attributions of knowledge to the experts, $F(2, 59) = 1.88, p = .16$. Children in both age groups (preschool: $M = 7.58, SD = 1.43$; elementary-school: $M = 8.00, SD = 0$) as well as adults

($M = 8.00$, $SD = 0$) correctly identified that experts were more knowledgeable about their respective domains (for preschoolers, $t(18) = 10.94$, $p < .001$; there was no variability in older participants' responses, so one-sample t-tests against chance could not be conducted). This is consistent with prior research demonstrating that children have an initial understanding of expertise by the late preschool years (Lutz & Keil, 2002).

Understanding an All-Knowing Beings' Breadth of Knowledge

To assess participants' understanding of the breadth of Ms. Smart's knowledge, they were asked whether she would know six different types of information (see Table 3-1). Preschoolers only attributed one type of knowledge to Ms. Smart above chance—knowledge of where to find the tallest tree in the world; essentially, knowledge of the present. Older children additionally granted to Ms. Smart knowledge of their birthday and favorite food—both pieces of personal information that are publicly displayed—but not knowledge of the child's mental states. In contrast, adults typically reported that Ms. Smart would know *all six* pieces of information. Thus, preschoolers were particularly conservative in their estimations of Ms. Smart's knowledge. This trend becomes especially clear when considering who attributed *all six* pieces of information to Ms. Smart—only 16% of preschoolers did so, compared to 63% of older children and 83% of adults.

Participants were asked to explain their answers for two of the six items: “Does Ms. Smart know who will win the Super Bowl next year?” and “Does Ms. Smart know what you're thinking right now?” Among preschoolers, who typically denied that Ms. Smart would know what they are thinking, most (54%) provided uninformative reasoning (e.g., “Because” or “I don't know”) while the remaining children referred to the private

nature of the mind (e.g., “My brain is hidden in my head,” “I didn’t tell her,” “I’m not talking to her”) or Ms. Smart’s inability to access the information (e.g., “He can’t see us”). Preschoolers and elementary-school children were equally skeptical of Ms. Smart’s knowledge of the next Super Bowl winner. Among children who denied that Ms. Smart would possess this knowledge, the most common explanation was that the event had not happened yet (40%) and that Ms. Smart was not capable of acquiring the knowledge (20%).

Understanding an All-Knowing Being’s Depth of Knowledge

Information outside of experts’ domains of expertise. To assess whether and at what age participants grant *greater* knowledge to Ms. Smart compared to more recognizable experts, participants were asked whether Ms. Smart or the experts would know more about information *outside* of the experts’ respective domains (see Figure 3-1). Attributions of greater knowledge to Ms. Smart differed between the three age groups, $F(2, 59) = 6.12, p < .01$. Compared to preschoolers, elementary-school children ($p < .05$) and adults ($p < .01$) attributed more knowledge to Ms. Smart on this task, according to Tukey HSD pairwise comparisons. However, and importantly, participants in every age group attributed more knowledge to Ms. Smart than to the experts (preschool children: $t(18) = 5.97, p < .001$; elementary-school children: $t(18) = 14.20, p < .001$; adults: $t(23) = 47.00, p < .001$). Thus, participants in each age group were willing to attribute greater knowledge to the new being, Ms. Smart, even compared to more familiar experts.

Information within experts’ domains of expertise. I next examined whether and at what age individuals grant greater knowledge to Ms. Smart *within* experts’ domains. This task is a more direct test of participants’ understanding of the depth of Ms. Smart’s

knowledge—in any given domain, Ms. Smart does not just know a lot, she knows *everything* and thus even more than experts. Figure 3-2 depicts participants' attributions of greater domain-specific information to Ms. Smart compared to the experts.

Attributions of greater knowledge to Ms. Smart differed significantly between the three age groups ($F(2, 59) = 9.02, p < .01$), with adults attributing to Ms. Smart more of such knowledge than did preschoolers ($p < .001$, according to Tukey HSD pairwise comparisons) or elementary-school children ($p < .05$, according to Tukey HSD pairwise comparisons). Analyzed separately, preschoolers typically attributed greater knowledge to the experts ($t(18) = -4.76, p < .001$), elementary-school children were at chance ($t(18) = -1.33, ns$), and adults typically attributed greater knowledge to Ms. Smart ($t(23) = 2.29, p < .05$).

Conceivably, the order in which participants were asked these questions may frame how they conceptualize the depth of Ms. Smart's knowledge. Elementary-school children attributed greater knowledge to Ms. Smart than to the experts when the first item per expert was within the expert's domain ($M = 4.56, SD = 4.10$) rather than outside the expert's domain ($M = 1.40, SD = 2.50$), $t(12.98) = 1.99, p = .067$, with correction for unequal variances between groups. Preschoolers' and adults' responses did not vary by question order.

Belief That Someone Can Really Know Everything

Before being introduced to Ms. Smart, participants were asked whether they had ever heard of anyone who knows everything. Most participants in each age group reported that they had *not* heard of anyone who knows everything. Fewer than half (42%) of the preschoolers said "Yes" (binomial $p = .65$), and this dropped to 21% among

elementary-school children (binomial $p < .05$), and 8% among adults (binomial $p < .001$). A similar developmental pattern emerged when, at the end of the interview, participants were asked whether someone can really know everything about everything: 37% of the preschoolers said “Yes” (binomial $p = .36$), 32% of the elementary-school children said “Yes” (binomial $p = .17$), and no adults said “Yes” (binomial $p < .001$). Thus, belief that someone can truly know everything is uncommon even among preschoolers. Of the seven preschoolers who said that someone could know everything about everything, one child mentioned that the knowledge would be acquired (“Being in college”), three mentioned people who are knowledgeable (“Because he [Mr. Smart] knows lots of things”, “My baby sister knows some stuff”, “Because I know everything”). The remaining three preschoolers provided uninformative reasoning (e.g., “I don’t know”). Of the seven elementary-school children who reported that someone can know everything about everything, all children explained that the knowledge would be acquired (e.g., “They read a lot and get smart”, “Maybe they’re really old and they live the longest and they learned a lot more and a lot faster”). Just one of these children mentioned (additionally) that the knowledge might be inherent, “if they were born with it.”

Discussion

The results of Study 3A demonstrate a slowly emerging understanding of omniscience, which seems to progress over many years. Elementary-school children and adults granted Ms. Smart knowledge about a variety of domains, including knowledge of the past and knowledge of some personal information, like birth dates and preferences. However, preschoolers were particularly conservative in their estimations of the breadth of Ms. Smart’s knowledge, only attributing to her knowledge of the here-and-now.

Surprisingly, both preschoolers and elementary-school children had difficulty conceptualizing the depth of Ms. Smart's knowledge, often reporting that experts hold more domain-specific information than she does. Most children reported that someone cannot really know everything about everything, and those who did explained that someone would *acquire* their knowledge through relatively ordinary means.

Because there are no prior data addressing these issues, Study 3A provides an important start. Of course a legitimate question relevant to a preparedness position, which claims not only that young children actually attribute omniscience to ordinary people but also that they are prepared to easily understand such a possibility, is whether the methods of Study 3A seriously underestimate children's understanding. For this reason, several changes were instituted in the next study 3B, including a greater emphasis on Ms. Smart's extraordinary mind. Study 3B also included additional measures to more sensitively assess children's understanding of the depth and breadth of an extraordinary being's knowledge and how it compares to the knowledge of ordinary people. Finally, Study 3B also considers cognitive and socio-cultural factors that might facilitate a developing understanding of omniscience.

Study 3B

In Study 3A, children's conservative estimation of the depth of Ms. Smart's knowledge might be the product of several factors, including: (a) some children's (particularly young children's) intuition that experts know everything about their respective domains; (b) not appreciating the depth of information to be known about a particular domain, thus reasoning that experts know all there is to know about their domains (or that experts and Ms. Smart are equally knowledgeable); (c) a deficit in

conceptualizing or applying the concept of “all-knowingness”, or (d) if able to conceptualize “all-knowingness”, a resistance to the idea that someone could *really* know everything and thus a refusal to apply that capacity to Ms. Smart. The youngest children were also conservative in the types (or breadth) of knowledge they attributed to Ms. Smart, often denying her knowledge of anything other than the here-and-now. This, too, may be a product of (c) or (d) above. To address these possibilities, the introductions to Ms. Smart and to the experts were modified in several ways in Study 3B.

To address (a) and (b), participants were offered corrective feedback about the depth of experts’ knowledge. For example, when participants were asked, “Does a mechanic know some things about cars, lots of things about cars, or everything about cars?”, if they responded “everything” they were told, “No. A mechanic knows lots of things about cars, but not everything.” To further address (b), for each comparison between Ms. Smart and an expert, an additional, broader, question was included (e.g., “Who knows more about cars, a mechanic or Ms. Smart?”). Compared to narrower questions (e.g., “Who know about why some *cars go very fast*, a mechanic or Ms. Smart?”), these broader questions ask participants to consider a greater amount of information and thus participants might think that Ms. Smart’s all-knowingness gives her a particular advantage over the experts. Note that these broader questions used the same language as that used in the corrective feedback about experts’ limited knowledge. For half of the children, one of these broad questions was asked first for each comparison between Ms. Smart and an expert; the other children received the broad item last in each comparison between Ms. Smart and an expert.

To address possibilities (c) and (d), Ms. Smart’s capacities were highlighted and elaborated in several ways in Study 3B. Children were told that Ms. Smart was born with a “very, very special brain”, and she was given a complementary larger cranium (a tactic often used by animators to highlight the intelligence of television and movie characters such as Jimmy Neutron, Megamind, Stewie from “Family Guy”, and Brain from “Pinky and the Brain”). To further highlight her extraordinariness, a bright glow emanated from Ms. Smart in her picture. To further reinforce the idea that Ms. Smart is indeed all-knowing, following her introduction, children were asked “Does Ms. Smart know some things, lots of things, or everything?” and were provided corrective feedback if needed—participants who reported that she knows anything less than “everything” were told, “No. Remember, Ms. Smart knows everything about *everything*”, while the interviewer spread his or her arms.

In Study 3A, an interesting developmental pattern emerged with respect to the *types* of knowledge that participants granted to Ms. Smart. Preschoolers granted to Ms. Smart knowledge of the present, but often denied her knowledge of the past, future, and personal information. Elementary school children additionally attributed to Ms. Smart knowledge of personal events and preferences, but not knowledge of the child’s mental states or knowledge of the future. However, this pattern raises questions. When a child denies that Ms. Smart holds personal knowledge (for example, about the child’s birth date or thoughts), is it because she is ignorant of others’ personal information in general, or just the *child’s* personal information? To address this, Study 3B included an additional complementary set of questions that referred to personal information about others (e.g., “Does Ms. Smart know what your *dad* is thinking right now?”). Participants were asked

whether Ms. Smart knows four forms of personal information—events, behavior, preferences, and thoughts. To examine consistency in responses, in Study 3B, participants were asked two (rather than one) question about Ms. Smart’s knowledge of non-personal information—facts about the past, present, and future. For example, to assess whether participants understood that Ms. Smart holds knowledge about the future, they were asked whether she would know about the weather next year and about the population next year. Conceivably, the additional measures taken to emphasize Ms. Smart’s extraordinariness might increase children’s willingness to grant these types of knowledge to Ms. Smart.

Study 3A raised additional questions that I address with Study 3B. First, although the youngest children only granted to Ms. Smart one type of knowledge above chance—readily-accessible information about the here and now—children did grant Ms. Smart other forms of knowledge at chance levels. This raises the question of whether children were actually responding to these questions randomly or if *some* children did genuinely grant Ms. Smart these other forms of knowledge. A stronger case can be made regarding children’s understanding of extraordinary mental abilities if they simultaneously attribute extraordinary knowledge to Ms. Smart but *deny* that knowledge to a non-extraordinary being. To address this issue, in Study 3B participants were additionally asked a set of identical questions about an ordinary human—their mother. Their mother serves as a particularly good comparison because: (a) their mother was used as an agent by Lane et al. (2010; in press), (b) children’s parents presumably do have access to personal information about them (e.g., their favorite food and date of birth), (c) children are familiar with their mothers and are thus exposed more often to her ordinary cognitive

shortcomings, (d) for Study 3A, some children named family members as people who know everything, and (e) it addresses some parents' lay intuitions that their children think they are all-knowing.

The development of other cognitive capacities likely supports a developing understanding of omniscience, and I consider two such capacities in Study 3B. First, an understanding of omniscience may be contingent upon an ability to conceptualize extremely large quantities or to conceptualize *limitlessness*. Conceivably then, an understanding of omniscience may share some of the cognitive underpinnings needed to represent the concept of infinity. Thus, I use tasks similar to those employed by Falk (1994; Falk & Ben-Lavy, 1989) to assess participants' understanding of the infiniteness of number. It is also possible that a more general ability to imagine improbable phenomena might underpin children's developing understanding of omniscience—itsself unlikely (indeed, nonexistent in the natural world). Thus, Study 3B includes additional questions similar to those used by Shtulman (2009; Shtulman & Carey, 2007) to measure children's belief in the possibility of improbable events, as well as questions similar to those asked by Wellman and Estes (1986), to assess children's ability to think about unlikely events. An ability to *think* about unlikely events (a dog that flies) emerges during the preschool years (Wellman & Estes, 1986), whereas preschoolers rarely report that improbable events (e.g., someone drinking onion juice) are actually *possible* (Shtulman, 2009; Shtulman & Carey, 2007). Rather, a willingness to entertain the possibility of improbable events increases gradually throughout middle and late childhood. Conceivably, both of these measures are tapping children's ability to *imagine* unusual phenomena—to picture those things happening in their minds or in real life—and thus

may be predictive of children's ability to entertain ideas about (improbable) omniscient beings.

Cognitive factors are not solely responsible for children's developing understanding of ordinary minds and are likely not solely responsible for children's understanding of extraordinary minds either. As demonstrated by Lane et al. (in press) socio-cultural input about beings with extraordinary minds—specifically, exposure to ideas about the Judeo-Christian God—can play an important role in this development. Thus, for Study 3B, I obtained additional information about participants' exposure to media about God as well as their religious involvement. As many religions consider God to be all-knowing, it is conceivable that exposure to information about God will influence children's appreciation of omniscience.

Because of the additions to Study 3B, it was necessary to prune other elements from the interview, in order to keep the interview brief enough for the youngest children to complete. First, because the bar graph used at the beginning of Study 3A might concretize the concept of “everything”, it was removed from Study 3B. I also removed the questions where experts were compared against one another—children performed at ceiling for Study 3A, consistent with the findings of Lutz and Keil (2002). Thus, I established that even preschoolers can distinguish between the knowledge possessed by the four experts. Since the same experts were being used in Study 3B, I eliminated this set of questions.

Finally, a theory of ordinary minds develops rapidly during the preschool years and so may an understanding of extraordinary minds. Thus to better capture a potentially rapid and nuanced early developmental trajectory, Study 3B includes a sizeable number

of children at an age before they typically develop a robust representational theory of mind (3 to 4.5 years), and at an age after they have typically developed a representational theory of mind (4.5 to 6.5 years), in addition to a group of older elementary-school children (6.5 to 11 years), and group of young adults (18 to 21 years). Having the sample split into these four age groups also allows me to better assess *when* in development other cognitive and contextual factors are likely to exert their greatest influence.

Method

Participants

Participants included three groups of children: 32 children 3 to 4.5 years ($M = 3.88$, $SD = .42$ years), 29 children 4.5 to 6.5 years ($M = 5.27$, $SD = .69$ years), and 28 children 6.5 to 11 years ($M = 8.86$, $SD = 1.41$ years) from southeastern Michigan. Thirty-four young adults (M age = 19.35, $SD = .78$ years) participated, all of whom were recruited through the University's Introduction to Psychology Subject Pool. Five children (1 three-year-old, 3 four-year-olds, and 1 five-year-old) were excluded from analyses because they were not paying attention to the tasks or because they decided to end the interview session early, resulting in a sample of 28 children 3 to 4.5 years, and 28 children 4.5 to 6.5 years. Participants were primarily White and of middle- to upper-middle-class socioeconomic status. Sixty-seven parents (80%) completed follow-up questionnaires about children's engagement in various activities, exposure to media, and frequency with which they attend a place of worship. All adult participants completed similar follow-up questionnaires concerning their engagement in various activities and their religious exposure.

Procedure and Measures

Participants were administered tasks similar to those from Study 3A, with some critical changes and additions. For Study 3B, Ms. Smart’s (for boys, Mr. Smart’s) extraordinary mind was further emphasized—she was given a larger cranium, she emitted a glow, and participants were additionally told that she was born with a “very, very special brain.” The new introduction and image of Ms. Smart can be found in Appendix E. Following her introduction, children were asked if Ms. Smart knows “some things, lots of things or everything” (half of the participants were asked if she knows “everything, lots of things, or some things”). Participants who did not respond “everything” were offered corrective feedback: “No. Remember, Ms. Smart knows *everything about everything* [interviewer spreads arms wide].” For these questions, and for all of the following questions, if participants replied “I don’t know” or did not provide an answer they were encouraged to provide an answer (e.g., “You can answer however you like; there are no wrong answers”, the question was repeated, and, for closed-ended questions, response options were given). Additional changes to the protocol for Study 3B are described below.

Understanding experts’ depth of knowledge. Participants were presented the same four experts as in Study 3A—a doctor, mechanic, chef, and pilot—and were asked how much each expert knows about their respective domain (e.g., “How much does a doctor know about being healthy? Some things, lots of things, or everything?”; half of the participants were given these options in reverse order). To avoid concretizing “everything”, participants were not shown a graph representing the three amounts (though several 3-year-olds had difficulty answering the questions without a visual aid,

so interviewers resorted to using the graph for them). Participants were provided corrective feedback if they reported that any expert knows everything, “No. ___ knows *lots* of things about ___, but not *everything* [spread arms].”

Understanding an all-knowing being’s depth of knowledge. To examine participants’ understanding of the depth of Ms. Smart’s knowledge, across 20 questions (five per expert), they compared the knowledge held by Ms. Smart and each of four experts. To limit the influence of the characters’ appearance (rather than their knowledge), images of Ms. Smart and the experts were flipped over before asking the questions. Participants could either name their choice or point to her (flipped over) picture. Eight of these questions referred to knowledge outside of the experts’ domains (e.g., “Who knows more about how a TV works, a doctor or Ms. Smart?”), four were questions that referred to the experts’ knowledge domains broadly (e.g., “Who knows more about being healthy, a doctor or Ms. Smart?”), and eight dealt with more specific information within the experts’ domains (“Who knows more about why you get a tummy ache, a doctor or Ms. Smart?”). Because elementary-school children in Study 3A attributed (marginally) more knowledge to Ms. Smart when first reasoning about knowledge within the experts’ domains, all participants in Study 3B were first asked questions referring to information within the experts’ domains. For half of the participants, comparisons between Ms. Smart and each expert began with an item about the expert’s domain broadly (e.g., “Who knows more about cars; a Mechanic or Ms. Smart?”); half of the participants received orders that began with a question about more specific information within the expert’s domain (e.g., “Who knows more about what cars

are made of; a Mechanic or Ms. Smart”). For the complete pool of questions, see Appendix C.

Understanding an all-knowing being’s breadth of knowledge. After being introduced to Ms. Smart (and reminded that she knows “everything about everything”), participants were asked 14 yes/no questions about the types of knowledge Ms. Smart possess. These 14 items fell into seven categories: three non-personal categories (facts about the past, present, and future) and four personal categories (facts about one’s own and others’ behavior, events, preferences, and thoughts). For a complete list of questions, see Appendix F. Open-ended follow-up questions were asked following participants’ answers to five of these items: knowledge of what their father’s favorite food is, knowledge of their behaving naughty, knowledge of what they are thinking of, knowledge of their father’s birthday, and knowledge of the weather next summer. For each of these items, if participants answered “Yes” they were asked, “How did she know?”, and if they answered “No” they were asked, “Why not?”

Understanding mom’s breadth of knowledge. Participants were asked whether their mother knows each of the 14 pieces of information that were asked regarding Ms. Smart.

Understanding infinity. To assess participants’ understanding of limitlessness, they were administered an infinity task patterned after a measure used by Falk (Falk, 1994; Falk & Ben-Lavy, 1989). This task was chosen because, unlike several other existing infinity tasks, it has revealed clear developmental trends across several studies. There were three components to this task. First, participants were presented two images (leaves and hairs) and asked “What are there more of, leaves on all the trees in on Earth,

or hairs on all people's heads?" Participants could respond by naming or pointing to their choice. The set that was judged larger was compared to the amount of sand ("What are there more of, [previous choice] or all of the grains of sand on Earth?") as participants saw a picture of their previous choice and a picture of sand side-by-side. The set that was judged largest was then compared, in the target question, to the set of all numbers: "What are there more of, [previous choice] or all the numbers?"

The second component began by asking participants to name the largest number they could think of, whether there is a number bigger than that, and if there is a number even bigger than that one. These questions were asked to get participants thinking about the never-ending nature of numbers. Then, participants were asked the focal question: "Do numbers ever stop or do they go on and on and on?"

For the third component, participants were shown a horizontal line with progressively smaller arrows on the right side and told "This line shows how many things there are. This side [the left] shows that there are just a few things; and this side [the right] shows that there are lots and lots of things. So, if the amount of [sand/leaves/hair] goes here [experimenter writes child's last choice beside a hatch mark near the right end of the line], is it possible to show where the amount of numbers goes on this line?" If participants responded "yes", they were invited to draw a hatch mark on the line indicating where the amount of numbers goes. If participants answered "no", they were asked "Why?" A correct answer to this final question is "no," since the infinity (of numbers, or anything else) cannot actually be represented on a number line.

Belief that someone can know everything. To gather more information on participants' understanding of the capacities and constraints of the mind, they were asked

several more questions about their knowledge of beings with extraordinary mental abilities. These questions included, “Have you ever heard of anyone else who knows everything about everything?” and if so, “Who?”; “What kinds of things will [person/being] know about?”; and “Do you think someone can *really* know everything about everything?” If so, “How?” and if not, “Why not?”

Religious exposure. Parents of all children were distributed a questionnaire—similar to that used by Lane et al., 2010, in press—which asked about children’s daily activities and exposure to various media. Focally, parents answered four questions about how often their children are exposed to media about God: “How often do you read to/tell your child stories about God?”; “How often does your child listen to music that mentions God?”; “How often does your child watch movies or TV shows that mention/portray God?”; and “How often does your child play games or play with toys that depict or mention God.” Responses to each of these four questions could range from (0) Never to (4) Daily. An *exposure-to-God* score was computed by averaging across these four items (cronbach’s $\alpha = .89$). The questionnaire also asked how often children attend a place of worship, with response options ranging from (1) Never, to (5) Daily. Sixty-seven parents (80%) completed this voluntary questionnaire. All adult participants completed a similar questionnaire about their own engagement in various activities, including activities involving God concepts (e.g., listening to music about God, reading about God), and how often they attend a place of worship, and a similar *exposure-to-God* score was computed (cronbach’s $\alpha = .68$).

Imagining the improbable. Entertaining the idea that a being can possess extraordinary knowledge may depend upon an ability to imagine unlikely phenomena. To

examine this possibility, participants were asked whether they had seen, whether they could think about, or whether it was really possible for four improbable events to occur (see Appendix G). These items were derived from those used by Shtulman (2009; Shtulman & Carey, 2007) and by Wellman and Estes (1986). Participants earned a point for each event that they reported either (a) they could think about, or (b) could really happen. An *imagining-the-improbable* score was computed by summing scores across the four events (range: 0-4). To examine whether any relations between these questions and the focal measures may simply reflect a “Yes” bias (a more general tendency to answer “Yes” to Yes/No questions), another, theoretically-unrelated, variable was computed from these questions—a *seen-the-improbable* score (ranging from 0-4). This variable was included in certain analyses to detect effects that might simply stem from a “Yes” bias.

Coding. A coding system for all of the open-ended responses was developed through an iterative process. These included responses to open-ended questions concerning Ms. Smart’s and Mom’s breadth of knowledge, participants’ knowledge of anyone or anything who knows everything about everything and the types of knowledge those beings would possess, whether someone can really know everything about everything, and participants’ justifications for why they could not indicate the location of numbers on the line for the Infinity task. Lane and two research assistants developed an initial coding system, individually coded small subsamples of data, and compared coding. Discrepancies were discussed among the three coders, and the system was modified to limit future discrepancies. To establish inter-rater reliability with the final coding system, data were categorized independently by Lane and one research assistant until a criterion of at least 85% inter-rater agreement was reached for each question, across 15% of the

data (25 interviews). Remaining discrepancies were discussed by both coders and resolved. Once this criterion had been met, the remaining open-ended responses were coded by the research assistant who had established inter-rater reliability.

Results

In what follows, a first set of analyses examines the effectiveness of changes made to Study 3B in increasing participants' attributions of knowledge to Ms. Smart, by directly comparing the performance of participants in Study 3A to those from Study 3B, for items that both studies had in common. Subsequent analyses used the entire Study 3B sample to examine the knowledge that participants attributed to Ms. Smart and how that compares to knowledge attributed to ordinary people, as well as participants' beliefs that all-knowing beings can exist. Finally, I present analyses focused on cognitive and socio-cultural factors that might facilitate an understanding of omniscience.

Influence of Revised Protocol on Attributions of Knowledge to Ms. Smart

An initial set of analyses examined whether the changes made to Study 3B influenced participants' attributions of knowledge to Ms. Smart. For these analyses, age ranges were matched between the two studies (3.60 to 21 years). Thus, seven of the youngest children were excluded from the Study 3B sample, reducing the sample to 111. For these analyses, the Study 3B sample was also divided into the same three age groups used in Study 3A (preschoolers: $n = 36$; elementary-school children: $n = 35$; adults: $n = 34$).

First, I examined whether the elaborated introduction and information provided in Study 3B about Ms. Smart—her larger cranium, glow, and her “very, very special brain”, and the corrective feedback that was provided to participants about her “knowing

everything about everything”—as well as the corrective feedback offered about experts (that they know “lots of things, but not everything” within their domain) influenced the depth of knowledge that children attributed to Ms. Smart. Considering first participants’ attributions of knowledge to Ms. Smart outside of the experts’ domains, a 2 (study version: 3A, 3B) X 3 (age group: preschool, elementary-school, adult) ANOVA revealed a significant effect of age group ($F(2, 167) = 16.49, p < .001$), and a significant effect of study version, $F(1, 167) = 6.13, p < .05$. Overall, participants in Study 3B ($M = 7.80, SD = .77$) granted Ms. Smart greater knowledge than did participants in Study 3A ($M = 7.43, SD = 1.36$). Lack of an interaction effect indicated that the effect of study version did not vary by age group. A similar 2 (study version) X 3 (age group) ANOVA examined participants’ attributions of knowledge to Ms. Smart *within* experts’ domains. This analysis also revealed a significant effect of age group, ($F(2, 167) = 28.22, p < .001$) as well as a significant effect of study version, $F(1, 167) = 4.69, p < .05$. Overall, participants in Study 3B ($M = 4.49, SD = 3.65$) granted Ms. Smart greater knowledge *within* experts’ domains, compared to participants in Study 3A ($M = 3.39, SD = 3.68$). There was no significant interaction between age and study version. The main effects of age noted above mirrored those found in Study 3A, with older participants attributing greater knowledge to Ms. Smart. Developmental trends will be considered in greater detail later, using the full sample from Study 3B.

I next examined whether Study 3A and Study 3B participants differed in the *breadth* of knowledge they attributed to Ms. Smart. Table 3-2 shows participants’ attributions of knowledge to Ms. Smart, for the five items asked in both studies. In contrast to participants in Study 3A, preschoolers and elementary-school children in

Study 3B attributed all five forms of knowledge to Ms. Smart above chance. I next directly compared participants in the two studies. Preschoolers in Study 3B were significantly more likely to attribute to Ms. Smart knowledge about themselves, including knowledge of their birth date, their favorite food, and what they were thinking. Between the two studies, preschoolers were equally likely to report that Ms. Smart knows non-personal information about the past and present. There were no significant differences between the two studies for elementary-school children or adults.

Thus the revised protocol effectively increased the depth as well as the breadth of knowledge that participants, especially preschoolers, granted to Ms. Smart. All subsequent analyses are performed using the full sample from Study 3B ($N = 118$). To examine developmental trajectories more precisely, these analyses include participants in four age groups: 3.5 to 4.5 years, 4.5 to 6.5 years, 6.5 to 11 years, and young adults.

Of course, increased endorsement of Ms. Smart's knowledge in Study 3B does not necessarily show that participants understood that Ms. Smart's knowledge is particularly extraordinary, unless participants can also distinguish between her knowledge and the knowledge held by ordinary people. Thus, a particularly important contrast to consider is Ms. Smart versus the child's own mother. A child's mother might be considered by young children to be particularly capable and knowledgeable, so comparing Ms. Smart against mothers provides valuable insight into children's appropriate understanding of Ms. Smart's unique, extraordinary knowledge. These comparisons are included in the analyses in the next section.

Understanding Experts' Depth of Knowledge

To assess the depth of knowledge that participants attributed to experts, they were

asked how much each of the four experts knows about their respective domains—some things, lots of things, or everything. In contrast to Study 3A, participants were offered corrective feedback for this task—if participants reported that any expert knows “everything” about their domain, they were told that the expert knows lots of things, but not everything. There was a significant age difference in (incorrectly) attributing knowledge of “everything” to the first expert, $\chi^2(3) = 9.50, p < .05$. Roughly half (54%) of 3- to 4.5-year-olds attributed knowledge of “everything” to the first expert, compared to 46% of 4.5- to 6.5-year-olds, 21% of 6.5- to 11-year-olds, and 12% of adults. However, the corrective feedback appropriately reduced children’s attributions of “everything” to the experts. Whereas 54% of the youngest children attributed knowledge of everything to the first expert, only 17% attributed knowledge of everything to the last expert, $Z = -2.71, p < .01$. Among the 4.5- to 6.5-year-olds, a similar decrease was found between the first expert (46%) and last expert (12%), $Z = -2.71, p < .01$. No decrease in knowledge attribution was found among the older children or adults, who typically attributed knowledge of “lots of things” even to the expert presented first. Further demonstrating the effectiveness of the corrective feedback, there were no age differences in attributions of “everything” to the last expert, $\chi^2(3) = 3.00, ns$.

Understanding an All-Knowing Being’s Depth of Knowledge

Information outside of experts’ domains of expertise. Using the full Study 3B sample and four age-groups ($N = 118$) I assessed age differences in attributions of knowledge outside of experts’ domains to Ms. Smart; these data are presented in Figure 3-3. A one-way ANOVA revealed that knowledge attributions varied significantly between the four age groups, $F(3, 114) = 9.87, p < .001$. Three- to 4.5-year-olds, while

typically attributing more of this knowledge to Ms. Smart than to the experts, did so less than participants in the other three age groups ($ps < .05$, according to Tukey HSD pairwise comparisons). However, participants in every age group attributed greater knowledge to Ms. Smart (compared to the experts) at levels significantly above chance (for the two youngest age groups, $ts(27) > 11.00$, $p < .001$; all of the oldest children and adults performed at ceiling on this task and thus one-sample t-tests could not be computed).

Information within experts' domains of expertise. As mentioned earlier, a more convincing demonstration of understanding the depth of an omniscience being's knowledge is understanding that Ms. Smart possesses more knowledge than experts *within* their domains of expertise. The full sample from Study 3B was used to conduct a fine-grained examination of age differences in attributions of such knowledge to Ms. Smart; these data are presented in Figure 3-4. A one-way ANOVA revealed significant differences in knowledge attributions between the four age groups, $F(3, 114) = 16.89$, $p < .001$. Compared with children in each of the three age groups, adults more often attributed greater knowledge to Ms. Smart ($ps < .001$, according to Tukey HSD pairwise comparisons), and 6.5- to 11-year-olds attributed greater knowledge to Ms. Smart (marginally) more than 3- to 4.5-year-olds ($p = .09$, according to Tukey HSD pairwise comparisons). Analyzed separately, the youngest children typically attributed greater knowledge to the experts than to Ms. Smart ($t(27) = -3.99$, $p < .001$), children in both of the middle age groups were at chance (4.5 to 6.5 years: $t(27) = -1.21$, *ns*; 6.5 to 11 years: $t(27) = -.25$, *ns*), and adults typically attributed greater knowledge to Ms. Smart than to the experts, $t(33) = 8.04$, $p < .001$.

Study 3B included four additional broad items (e.g., “Who knows more about cars; Ms. Smart or a mechanic?”), which might encourage children to think about the large amount of information there is within a domain. These items used similar language as the initial questions that participants were asked about experts’ depth of knowledge and for which they were offered corrective feedback if necessary (e.g., “A mechanic knows lots of things about cars, but not everything”). Thus, children may be more likely to attribute greater knowledge to Ms. Smart for these broader items. A *broad-item* composite was computed by averaging across the four broad items and a *narrow-item* composite was created by averaging across the eight narrow items, for scores ranging from 0 to 1. A 2 (question depth: narrow, broad) X 4 (age group) repeated measures ANOVA predicting children’s attributions of knowledge to Ms. Smart revealed no effect of question depth ($F(1, 114) = 1.96, ns$) and no significant interaction between question depth and age group ($F(3, 114) = 1.27, ns$); only a main effect of age group, $F(3, 114) = 19.18, p < .001$. Across all ages, participants were as likely to attribute greater knowledge to Ms. Smart on the four broad items ($M = .51, SD = .47$) as they were on the more narrow eight items ($M = .52, SD = .46$).

Understanding Mom’s Breadth of Knowledge

How children and adults attribute knowledge to ordinary humans serves as an important comparison to their attributions of knowledge to extraordinary beings, like Ms. Smart. Participants were asked if their mothers possess each of 14 pieces of information that constituted seven categories of knowledge. As a conservative estimate of participants’ attributions of *categories* of knowledge to their mothers (as opposed to just individual pieces of information), they needed to attribute to their mother *both* pieces of

information within the category. For example, to consider a child as having attributed knowledge of the *future* generally to mom, he or she had to report that mom would know both about the weather next summer and would know how many people will live on Earth next year. As depicted in Table 3-3, children in all three age groups as well as adults attributed to their mothers knowledge of personal preferences (their own and their father's food preferences). All participants also attributed to their mothers knowledge of personal events (their own and their fathers' birthdays). No other forms of knowledge were attributed, above chance, to mothers. Moreover, the majority of participants in all age groups did not attribute all seven types of knowledge to mothers.

Understanding an All-Knowing Beings' Breadth of Knowledge

Using participants' attributions of the same seven categories of knowledge to Ms. Smart (who, in contrast to mothers, knows "everything about everything"), I examined participants' conceptualization of the breadth of Ms. Smart's knowledge. Preliminary analyses revealed that attributions of one's own personal information to Ms. Smart (averaging across items about one's own events, activities, thoughts, and preferences; $M = .85$, $SD = .29$) did not differ significantly from attributions of others' personal information to Ms. Smart ($M = .85$, $SD = .28$)—in a 2 (Person: Self, Other) X 4 (Age group) repeated-measures ANOVA predicting attributions of knowledge to Ms. Smart, there was no effect of person or interaction between person and age group. Thus knowledge of oneself and others were combined into four categories: knowledge of personal events, activities, thoughts, and preferences. Attributions of the seven categories of knowledge to Ms. Smart are presented in Table 3-4. The youngest children in the sample (3 to 4.5 years) consistently attributed to Ms. Smart knowledge of the present and

future, as well as knowledge of others' thoughts and preferences. Slightly older children (4.5 to 6.5 years) additionally attributed to Ms. Smart knowledge of the past and knowledge of others' personal events (their own and their father's birthdays) and personal actions (their own and their friend's naughty behavior). However, omniscience is more than holding several types of knowledge, it is a state of holding *all* forms of knowledge. Only the oldest children (6.5 to 11 years) and adults consistently attributed *all seven* categories of knowledge to Ms. Smart.

To reiterate, it is important to know if such knowledge attribution is particular to Ms. Smart or if it is characteristic of children's knowledge attribution more generally. To assess this, attributions of knowledge to Ms. Smart and to mom were compared; these findings are also presented in Table 3-4. Participants in every age group attributed to Ms. Smart more knowledge of non-personal facts about the past, present, and future, and more knowledge of others' personal thoughts. Participants of all ages did *not* differ in their attributions of certain personal information to Ms. Smart and to mom—participants reported that both would know about their own and their fathers' personal events (birthdates) and preferences (favorite foods). Whereas the youngest children (3 to 4.5 years) were equally skeptical that their moms or Ms. Smart would know about their personal actions (i.e., their naughty behavior), older participants attributed more of such knowledge to Ms. Smart than to their mothers.

Thus, although the youngest children were relatively conservative in their estimations of Ms. Smart's knowledge, they understood that her knowledge would exceed that of ordinary people, in particular she was judged to know more non-personal information about the past, present, and future, and more about others' thoughts. The

reasoning that participants used in making their decisions sheds further light on their understanding of Ms. Smart's capacities. Following their response to each of five questions about Ms. Smart's knowledge, participants were asked an open-ended follow-up question: either "How?" if they reported that Ms. Smart would hold that knowledge, or "Why not?" if they reported that she would not hold that knowledge. Follow-up questions were asked concerning Ms. Smart's knowledge of: (1) what the participant is thinking, (2) whether the participant did something naughty, (3) what the participant's dad's favorite food is, (4) when the participant's dad's birthday is, and (5) what the weather will be like next summer. These five items were chosen because, in Study 3A, children often denied Ms. Smart knowledge of personal information and knowledge of the future, so I thought it would be particularly interesting to see children's reasoning about how a being could ever possess that type of knowledge; for example, whether such knowledge it is inherent or is acquired.

The reasoning that participants used to explain how Ms. Smart *would* hold certain knowledge is focal here, as it sheds light on participants' understanding of Ms. Smart's powers and how she acquires her knowledge. Participants' response fell into seven categories, six of which were frequently used; see Table 3-5. These six categories include: (1) explicit reference to "*knowing everything*", (2) references to Ms. Smart's *intelligence* (e.g., "She's the smartest person in the world", "She's got the smartest brain"), (3) explanations about how Ms. Smart would acquire information through *ordinary experience* (e.g., "She was spying on me", "She would ask people", "She took a recorder and stole it from the weather man"), (4) participants' volunteering the information or citing their *own knowledge* ("Because I'll know", "It should be like 80 to

100 [degrees next summer]”, “I’m really thinking about pizza right now”), (5) *other* reasoning which was informative but did not fit into any other category (e.g., “He’d be guessing”), and (6) *uninformative* responses, including “I don’t know” and “Because.”

The proportion of responses (across the five questions) for which each of the six forms of reasoning was used is presented in Table 3-5. These data reveal two noteworthy developmental trends. First, participants’ mention of Ms. Smart’s capacities—her knowledge of everything or her intelligence—increased from the preschool years, through the elementary-school years, to early adulthood. Second, compared to older participants (especially adults) preschoolers more often used alternative forms of reasoning, in particular reasoning that Ms. Smart would possess knowledge because the children themselves held the information (e.g., “I know it”) because she would acquire it through ordinary experiences (e.g., “She would spy on me”), or because of some other reason (e.g., when asked whether Ms. Smart would know when the child’s dad’s birthday is, one child responded “He’d be guessing” and another child responded “Because he’s easy”). Thus, for older children and adults, the fact that Ms. Smart knows everything about everything was reason enough for her to hold a broader variety of knowledge, whereas young children often came up with everyday mechanisms through which Ms. Smart would acquire information or they cited their own knowledge.

Belief That Someone Can Really Know Everything

At a young age, children attribute a broad set of knowledge to Ms. Smart, but do they *believe* that all-knowing beings can actually exist? Several additional questions were asked to address this issue. At the beginning of the interview, participants were asked whether they had ever heard of anyone or anything who knows everything about

everything. Half (50%) of the 3- to 4.5-year-olds said “Yes” (binomial $p = 1.00$), but this dropped with increasing age, to 27% among 4.5- to 6.5-year-olds (binomial $p < .05$), 14% among 6.5- to 11-year-olds (binomial $p < .001$), and 6% among adults (binomial $p < .001$). Parallel to these results, at the end of the interview, when asked whether there could be a real person like Ms. Smart, 63% of the youngest children said “Yes” (binomial $p = .31$), and so did 34% of 4.5- to 6.5-year-olds (binomial $p = .17$), and 7% of 6.5- to 11-year-olds (binomial $p < .001$), but no adults said “Yes” (binomial $p < .001$). Finally, when asked at the end of the interview if someone can really know everything about everything, about half (46%) of the youngest children said “Yes” (binomial $p = .84$), and this decreased to 19% of 4.5- to 6.5-year-olds (binomial $p < .01$), 18% of 6.5- to 11-year-olds (binomial $p < .01$), and none of the adults (binomial $p < .001$).

Thus, the youngest children (3 to 4.5 years) neither believed, above chance, that omniscient beings exist nor that omniscience is even really possible, and indeed children as young as 4.5 to 6.5 years often reported, above chance, that such capacities are *not* possible. However, a sizeable number of children between 3 and 6.5 years did answer these questions in the affirmative. Who did these children have in mind and what types of knowledge did children assume they held? Participants who reported that they had heard of someone or something who knows everything were asked “Who?”, and “What kinds of things will ___ know about?” Participants could provide multiple responses to these questions. Three- to 6.5-year-olds most often mentioned family members (39%) or professionals (e.g., doctors or teachers; 17%), but also referred to a range of other people, beings, and artifacts (Bob the Builder, friends, “You”, “Your mom”, “Nick”, “God”, “A monster truck”; 30%). The most common forms of knowledge that children attributed to

these beings were knowledge of objects (e.g., “basketballs, soccer balls, footballs, baseballs”, “how bricks and houses are made”; 25%), people (“She knows about a person who flies planes”, “firefighters”; 25%), and nature (e.g., “when the snow falls”, “She knows about holes that have water in it and dirt”; 15%). Several children (20%) reported that such beings would know how to *do* certain activities (e.g., “kicking”, “how to make bread, jelly, and peanut butter”, “What direction to go to take people to fly”).

Among the participants who affirmed that someone can really know everything about everything, what was their rationale? First consider the reasoning used by the youngest children (3- to 4.5-year-olds) who had the most limited understanding of Ms. Smart’s knowledge. Of the 13 youngest children who claimed that such beings could exist, most either mentioned someone who knows everything, like Ms. Smart or a parent (31%), or provided uninformative reasoning, including “I don’t know” and “Because” (42%). Next consider the older children (4.5 to 11 years), who had a more sophisticated understanding of what it means to know everything about everything. Of the 11 older children who reported that an all-knowing being could really exist, the most common responses were explanations that someone could *acquire* that knowledge during their lifetimes (e.g., “If they start reading science books and everything books when they’re first born”, “By going on the computer”; 55%), and references to someone who knows everything, like Ms. Smart or God (18%).

Relations between Understanding Omniscience and Understanding Infinity

Potentially, an ability to conceptualize very large quantities (or perhaps limitlessness) may underlie both children’s understanding of omniscience as well as their understanding of infinity. Thus, one may expect to find significant relations between

understanding omniscience and understanding infinity. First, I will present developmental trends in participants' responses to the three components of this task. For the first component, when asked to compare a large but finite amount to all of the numbers (e.g., "What are there more of, all of the grains of sand on Earth, or all of the numbers?"), 43% of children 3 to 4.5 years, 46% of children 4.5 to 6.5 years, 57% of children 6.5 to 11 years, and 94% of adults accurately reported that there were more numbers. For the second component, when asked if numbers stop or if they go on and on, there was also a clear developmental trend in reporting that numbers continue: 54% of children 3 to 4.5 years, 70% of children 4.5 to 6.5 years, 82% of children 6.5 to 11 years, and 100% of adults reported that numbers go on and on. For the third component, participants were asked whether it was possible to indicate on a number line where the largest number goes. Participants were considered correct if they replied "No" and provided a relevant justification (by explaining that numbers are too large or that the line is too small). Performance on this third component also increased with age: 4% of 3- to 4.5-year-olds, 4% of 4.5- to 6.5-year-olds, 32% of 6.5- to 11-year-olds, and 74% of adults responded correctly.

An *understanding infinity* composite was computed as the number of components that participants understood, for potential scores ranging from 0 to 3. Means and standard deviations for this measure, per age group, are presented in Table 3-6. Partial correlations for each age group (additionally controlling for age within each age group) revealed that understanding infinity was significantly related to the depth of knowledge that participants attributed to Ms. Smart (i.e., attributing more knowledge within experts' domains to Ms. Smart), but this was only the case among 6.5- to 11-year-olds,

$r(25) = .38, p = .05$. For all age groups, understanding infinity was unrelated to the breadth of knowledge attributed to Ms. Smart.

Relations between Understanding Omniscience and Imagining the Improbable

Potentially, entertaining the idea that Ms. Smart possesses extraordinary knowledge may depend upon a more general ability to imagine improbable phenomena. To assess this possibility, participants were asked whether they could think about or whether it was really possible for four improbable events to occur (see Appendix G). Participants earned a point for each event that they reported could really happen or that they could think about, for an *imagining-the-improbable* score ranging from 0 to 4. Table 3-6 presents means and standard deviations for this measure, for each age group. Table 3-7 displays partial correlations between participants' ability to imagine the improbable and their attributions of knowledge to Ms. Smart, controlling for age within each of the four age groups. Overall, an ability to imagine the improbable was significantly related to children's attributions of six of the seven categories of knowledge to Ms. Smart, as well as a composite summing across the seven categories, but this was true only among the oldest children (6.5- to 11-year-olds). An ability to imagine the improbable did not predict attributions of knowledge within experts' domains to Ms. Smart, for any age group. Thus, an ability to entertain the improbable is related to older children's understanding of the breadth, but not the depth, of Ms. Smart's knowledge.

These relations do not merely reflect individual differences in a tendency to answer "Yes" to all Yes/No questions—a "Yes" bias. If so, there would be positive relations between children's attributions of knowledge to Ms. Smart and any other measure that called for Yes/No responses. However, as illustrated in Table 3-7, 6.5- to

11-year-olds' *seen-the-improbable* scores (their tendency to report that they saw the four unlikely activities) was unrelated to the breadth of knowledge they attributed to Ms. Smart. Moreover, the relations between imagining the improbable and knowledge attributions were specific to Ms. Smart—6.5- to 11-year-olds' ability to imagine the improbable was unrelated to the knowledge they attributed to their mothers.

Relations between Understanding Omniscience and Religious Exposure

Potentially, participants' exposure to ideas about beings with extraordinary minds might facilitate an understanding of omniscience. Data on participants' religious affiliation, exposure to media and activities involving the idea of God, as well as the frequency with which participants attend a place of worship were provided by 80% of parents who completed a follow-up questionnaire, and by all adult participants who completed a similar questionnaire about themselves. Among the 67 children whose parents provided data, 42 (63%) children attended a place of worship. Of these, 11 attended rarely, 9 attended monthly, and 22 attended weekly. Parents of 51 of these children (76%) identified with Christianity. Among the 34 adult participants, 23 (68%) attended a place of worship; 7 rarely, 8 monthly, and 8 weekly. The most common belief systems that participants identified with were Christianity (59%) and Agnosticism (12%). Table 3-6 presents means and standard deviations for participants' exposure to media about God, per age group.

Table 3-8 presents partial correlations between participants' exposure to media about God and religious attendance on one hand, and attributions of knowledge to Ms. Smart on the other hand, controlling for age within each age group. In sum, exposure to ideas about God correlated significantly with attributions of knowledge to Ms. Smart

only among 4.5- to 6.5-year-olds, an age shortly after most children have acquired a robust representational theory of mind. For these children, greater exposure to media about God or more frequently attending a place of worship were either individually or both significantly related to children's attributions of three of the seven categories of knowledge to Ms. Smart—knowledge of the past, present, and personal events—as well as the composite measure summing across the seven categories. These relations were specific to Ms. Smart—among 4.5- to 6.5-year-olds, religious exposure was unrelated to the knowledge they attributed to their mothers.

Interestingly, a different trend emerged for the oldest children (6.5 to 11 years)—exposure to media about God and attending a place of worship were generally *negatively* related to attributions of different types of knowledge to Ms. Smart. However, only one of these relations was statistically significant—children who were exposed to more media about God attributed less knowledge of the present to Ms. Smart. Religious exposure was unrelated to the depth of knowledge (i.e., knowledge within experts' domains) that participants attributed to Ms. Smart, and this was true for all age groups. Thus, religious exposure is related to children's understanding the breadth, but not the depth, of omniscient beings' knowledge.

Study 3 General Discussion

By the late preschool years, children understand that certain beings possess extraordinary mental capacities that exceed the limits of ordinary human minds. Most research that demonstrates this has taken a singular approach—examining whether children attribute to extraordinary beings readily-accessible (though somewhat obstructed) knowledge about the here-and now; knowledge that ordinary people would

typically not possess (e.g., Barrett et al., 2001; Giménez-Dasí et al., 2005; Lane et al., 2010; Makris & Pnevmatikos, 2007; Richert & Barrett, 2005). Moreover, most of these studies have been limited in that children themselves typically possessed the knowledge that they attributed to extraordinary beings. Thus, in those studies, children’s attribution of knowledge to others might have simply been the product of a “curse of knowledge”—an over-attribution of one’s own knowledge to others, a tendency that even adults exhibit (for reviews, see Birch & Bloom, 2004; Nickerson, 1999). To demonstrate an understanding of omniscience, children must attribute more than their own knowledge to an all-knowing being.

Though limited, this prior work laid the foundation for research on children’s understanding of extraordinary mental capacities. In the current studies, I comprehensively examined the progressive development of an understanding of extraordinary minds from the preschool years to early adulthood. Using novel tasks, I examined the breadth of knowledge that children and adults attributed to a being whom they were instructed “knows everything about everything”—Ms. Smart. By “breadth” I am referring to the *kinds* of knowledge that participants attributed to Ms. Smart. Importantly, in contrast to prior studies, the types of knowledge that participants considered were not limited to factoids about the here-and-now, but also included information about the past and future as well as personal information. Participants also considered whether Ms. Smart possesses information that they were familiar with (e.g., their favorite food) as well as information that participants did not themselves possess (e.g., what the weather will be like next summer). Study 3 additionally examined the depth of knowledge that children and adults attribute to all-knowing beings. By “depth”, I

am referring to the amount of knowledge that participants attributed to Ms. Smart *within* a given domain.

The *preparedness hypothesis* holds that, because young children's default assumption is that all minds are infallible, young children should be particularly able and willing to attribute all types of knowledge (as well as complete knowledge about every domain) to Ms. Smart. "If the *preparedness hypothesis* is correct, it would predict that children should easily be able to incorporate the sense of infallibility into their concepts, even of nonreligious entities. In other words, making salient particular features of agents that otherwise have human-like attributes should influence children's responses for these entities" (Richert & Barrett, 2005, p. 286). However, this is not what I found. Consider first the breadth of knowledge that children attributed to Ms. Smart. In Study 3A, preschoolers only attributed to Ms. Smart knowledge of one (out of six) pieces of information—where to find the tallest tree in the world; an accessible fact about the here-and now that can be retrieved through ordinary means. In fact, only 16% of preschoolers attributed all six pieces of information to Ms. Smart. Contrast this with elementary-school children who attributed four of the six pieces of information to Ms. Smart, including knowledge of the past and some personal information (e.g., participants' favorite foods); and adults who *typically* attributed all six pieces of information to Ms. Smart, including knowledge about the future and about private thoughts.

It seems that, relative to older children and adults, preschoolers are particularly *conservative* in the breadth of knowledge they attribute to extraordinary beings. These findings seem to lend more support to an anthropomorphism hypothesis—young children tend to think of many agents, including extraordinary agents, as constrained by ordinary,

human, mental limits. This tendency is relaxed over the course of development, as children grant an increasingly broad body of knowledge to extraordinary beings, eventually including knowledge that people are not likely to possess (e.g., knowledge of strangers' birth dates and food preferences) and, by adulthood at least, knowledge that would be *impossible* to possess (e.g., knowledge of what strangers are thinking).

However, preschoolers are not entirely incapable of attributing a broad body of knowledge to extraordinary beings. Indeed, in Study 3B, when provided a more elaborated introduction and background information about Ms. Smart, and when provided corrective feedback about her knowledge, preschoolers attributed each of five pieces of information (five of the six items from Study 3A) to Ms. Smart above chance, and more than half of the preschoolers attributed *all five* pieces of information to Ms. Smart. However, even with this extensive training, an understanding of Ms. Smart's breadth of knowledge was clearly not an understanding of omniscience as outlined earlier and as usually understood theologically. Moreover, an understanding of extraordinary beings' breadth of knowledge was not consolidated or consistently applied among preschoolers, especially when compared to older children and adults. In Study 3B, participants 4.5-years and older consistently attributed to Ms. Smart knowledge of non-personal information about the past, present, and future, as well as knowledge of others' personal events, actions, thoughts, and preferences. In contrast, in Study 3B, 3- to 4.5-year-olds did *not* consistently attribute to Ms. Smart knowledge of the past, personal events, or personal actions, which complements findings from Study 3A, where preschoolers also denied Ms. Smart knowledge of the past and personal information.

Perhaps young children denied Ms. Smart knowledge of the past because young children consider that information less accessible (it has already passed and cannot be retrieved), whereas information about the present can be learned now and information about the future can either be learned later or can be derived from one's understanding of the current state of the world. This interpretation is admittedly post-hoc, and future studies should more systematically examine children's understanding of how information about the past and future is acquired by extraordinary beings. Preschoolers' tendency to deny Ms. Smart knowledge of others' actions and events (but attribute to her knowledge of others' thoughts and preferences) is also interesting. This may reflect the types of information that children can access about themselves—a young child can report on his thoughts and preferences but may not know his birth date, and may assume that strangers do not know either. Children's reasoning sheds some light on why they often denied Ms. Smart knowledge of others' actions, in this case, misbehaving. Some children explained that Ms. Smart would not know about their naughty behavior because they would not misbehave (e.g., "Because I wouldn't do anything bad"), and thus there was nothing for Ms. Smart to know.

The reasoning that participants used to explain why Ms. Smart *does* possess knowledge sheds additional light on the capacities that participants attributed to Ms. Smart. Two developmental trends are noteworthy. First, participants' reference to Ms. Smart's capacities—her knowledge of everything or her intelligence—increased steadily from the preschool years to early adulthood. Second, compared to older participants (particularly adults) preschoolers used more alternative forms of reasoning, including reasoning that Ms. Smart holds knowledge because children themselves hold the

information, or because Ms. Smart would *acquire* it through ordinary experiences (e.g., by asking someone). Indeed, among children who reported that someone can know “everything about everything”, many explained that the knowledge would be acquired through relatively ordinary means—through television, books, and conversations with others. Thus, for older children and adults, the fact that Ms. Smart “knows everything about everything” was sufficient for her to hold a wide variety of knowledge. In contrast, younger children often reasoned about the means and mechanisms through which that information could be acquired.

Thus, although it does not come intuitively, with extensive training older preschoolers can grasp that an extraordinary being—someone described in ways that adults would understand as omniscient—has a broad (though incomplete) body of knowledge, including knowledge that children themselves do not hold. Moreover, they appreciate that such a being holds a variety of knowledge that other ordinary people (in this case, their mothers) do not possess. However, it is important to note that these methods may have overestimated the breadth of knowledge that young children actually attribute to omniscient beings. The questions that children were asked called for “Yes” or “No” answers (i.e., to report that Ms. Smart knows X, all participants needed to do was say “Yes”). Young children in particular, have a well-documented “Yes” bias—a tendency to respond “Yes” to Yes/No questions in order to please the experimenter, to seem agreeable, or to seem competent (Okanda & Itakura, 2010). The methods of Study 3B provide some assurance against the interpretation that children’s knowledge attributions were merely driven by a general “Yes” bias. In particular, participants were asked identical Yes/No questions about the breadth of Ms. Smart’s knowledge and the breadth

of their mothers' knowledge, and even the youngest children granted Ms. Smart several forms of knowledge that they often denied to their own mothers. Still, future research should examine not just when children affirm that an all-knowing being possesses certain knowledge, but also how children reason about how all-knowing beings acquire that information (e.g., Is it there at birth or learned through relatively ordinary processes?) and how they use that information (e.g., Can Ms. Smart use her knowledge of the weather to plan her next vacation?).

Next, consider results on the *depth* of knowledge that participants attributed to Ms. Smart. For participants to truly grasp omniscience, they must appreciate that Ms. Smart holds more knowledge about a given domain than any other ordinary person, including experts. Thus, Ms. Smart was pitted against four experts and participants were asked who knows more about information outside and within the experts' domains of expertise. Participants' attributions of knowledge within the experts' domains is particularly revealing as it juxtaposes experts' large body of knowledge with Ms. Smart's even more substantial body of knowledge. Again, the preparedness hypothesis would predict that young children will be particularly capable on this task—they should always attribute more knowledge to Ms. Smart. But this is not what I found. In fact, when considering who holds more knowledge within the experts' domains, 3- to 4.5-year-olds overwhelmingly attributed greater knowledge to the experts. This was the case even in Study 3B, where Ms. Smart's powers were further emphasized, and where participants were specifically taught that Ms. Smart knows “everything about everything”, whereas the experts just know “lots of things” about their domains. Older children performed better on this task, but still underperformed when compared with adults, who almost

always attributed greater knowledge to Ms. Smart. Importantly, these results are not merely a product of the types of questions that children were asked or a more general preference for the experts over Ms. Smart—when reasoning about information outside of the experts’ domains, even the youngest children attributed more of such knowledge to Ms. Smart.

Why was reasoning about the depth of Ms. Smart’s knowledge so difficult relative to reasoning about the breadth of her knowledge? When considering the types of knowledge that Ms. Smart holds, children could have employed a simple heuristic: if there is something to be known then Ms. Smart knows it. That heuristic will always yield the correct answer (“Yes, she knows it”) for the breadth-of-knowledge questions, but the heuristic does not apply to the depth-of-knowledge questions, which require children to think beyond the mere absence or presence of a single piece of knowledge. If this is indeed the heuristic that young children are employing, it may play a critical initial role in the emergence of a full-fledged understanding of omniscience—it allows children to loosen their constraints about the *types* of information a being can possess. However, even this initial loosening required substantial input and training about a being’s extraordinary mental abilities.

Much of the knowledge that participants considered for the depth-of knowledge task—knowledge of planes, cars, medicine, and food—is accessible and can be obtained through ordinary means like books and the internet. These topics were chosen on purpose; they were domains that even preschoolers are familiar with and this was a first attempt to examine the development of an understanding of the depth of extraordinary beings’ knowledge. However, because of its focus on commonplace domains of

knowledge, this measure might have overestimated participants', even adults', understanding of the depth of extraordinary beings' knowledge. Future studies should examine how children and adults conceptualize the depth extraordinary beings' knowledge in other domains, like knowledge of others' minds, knowledge of the origins of the universe, knowledge of the fate of the universe, and so on.

At this point, it is important to reiterate why Study 3 focused on Ms. Smart as opposed to God. One reason was to standardize the information that children received about an extraordinary being's mind. Children from different contexts undoubtedly vary in the extent to which they are exposed to ideas about the Judeo-Christian God, so if children do not understand a particular aspect of God's extraordinary mind, it might simply reflect their lack of knowledge about God rather than a fundamental difficulty conceptualizing extraordinary minds. Use of Ms. Smart allowed me to provide multiple converging pieces of evidence about her mental capacities as well as corrective feedback about her capacities, perhaps more input than religiously-schooled children receive about God's mind. This extensive and *immediate* input about Ms. Smart's mind was designed to capitalize upon any understanding that children may have of extraordinary minds, which children may not intuitively apply when reasoning about God's mind. Indeed, Lane et al. (in press; Study 2 of this dissertation) demonstrated that religiously-schooled 4-year-olds (who were knowledgeable about the Judeo-Christian God) found it easier to conceptualize the extraordinary knowledge possessed by a being whom they were taught and reminded "knows everything" (Mr. Smart), as opposed to God (about whom the interviewer taught children nothing).

A major aim of these studies was to identify socio-cultural factors that facilitate a developing understanding of the breadth and depth of knowledge possessed by all-knowing beings. Lane and colleagues (in press) demonstrated that children's exposure to ideas about the Judeo-Christian God—an omniscient being—may be particularly powerful in facilitating an initial understanding of extraordinary mental abilities. Thus, in Study 3B, I collected data on participants' exposure to these ideas. Parents reported on their children's engagement in activities that involve ideas about God, and adult participants reported on their own engagement in these activities. Both children's exposure to media about God (e.g., movies and stories) and the frequency with which they attended a place of worship predicted attributions of broader knowledge to Ms. Smart, but this was true only for children who had recently developed a representational theory of mind, consistent with the findings of Lane and colleagues (in press). Exposure to God concepts was unrelated to participants' understanding of the depth of Ms. Smart's knowledge.

The reason exposure to ideas about God is related to understanding an extraordinary beings' breadth of knowledge, but not her depth of knowledge, may have something to do with the specific messages children receive about God's extraordinary mind. Many of the messages that children receive may deal with specific *types* of knowledge that God holds (e.g., God knows what is in your heart, God knows if you misbehave), which may facilitate the general idea that God knows many things, even things that ordinary people do not know. This is precisely the understanding that children need to apply when considering Ms. Smart's breadth of knowledge. But, as discussed earlier, merely appreciating that a being knows many things is not enough to grasp the

depth of that being's knowledge. Future studies should systematically examine the types of messages that children receive about God's and other beings' (e.g., superheroes') extraordinary knowledge and mental powers.

Another major aim of Study 3 was to identify cognitive competencies that support an understanding of omniscience. Two candidates were considered. The first is an understanding of infinity, which develops during middle and late childhood (Falk, 1994; Falk & Ben-Lavy, 1989). The rationale was that both an understanding of infinity and an understanding of omniscience require one to think of extremely large quantities (numbers and knowledge, respectively), or perhaps limitlessness; and this might be particularly useful in understanding that an omniscient beings' knowledge exceeds the knowledge of experts (the measure of the depth of knowledge attributed to Ms. Smart). In Study 3B, an understanding of infinity was significantly related to understanding the depth of Ms. Smart's knowledge, but only among 6.5- to 11-year-olds. Understanding infinity was unrelated to the breadth of knowledge that these older children attributed to Ms. Smart. It is noteworthy that, of the three cognitive and socio-cultural variables considered, an understanding of infinity differed the most between the oldest children (6.5 to 11 years) and adults. A developing understanding of infinity between late childhood and early adulthood may account for the large increase in the depth of knowledge attributed to Ms. Smart between late childhood and early adulthood.

The second cognitive capacity that I considered in Study 3B was an ability to imagine the improbable, an ability that also develops progressively during middle and late childhood (Shtulman, 2009; Shtulman & Carey, 2007). The rationale here was that children do not actually interact with omniscient beings and thus may not entertain the

(improbable) notion that a being could possess so many forms of knowledge, especially knowledge that ordinary people do not possess; indeed even preschoolers often reported that all-knowing beings could not really exist. This imagining-the-improbable measure proved fruitful. Participants who were better able to imagine improbable phenomena also attributed to Ms. Smart a broader body of knowledge; but this was again only the case for the oldest children (6.5 to 11 years). An ability to imagine the improbable was unrelated to the depth of knowledge that children attributed to Ms. Smart.

Why were these cognitive factors—an understanding of infinity and an ability to imagine the improbable—related to an understanding of omniscience only among older children? As discussed earlier, younger children’s attributions of different types of knowledge to Ms. Smart may be guided by a simple heuristic: if asked whether Ms. Smart knows X, the answer is always “Yes.” Using this heuristic would allow the youngest children to attribute a wide variety of knowledge to Ms. Smart without having to actually imagine what it means for a being to know X. Older children on the other hand, might make a more concerted effort to actually imagine a being who can know X, and thus a capacity to imagine the improbable would be particularly helpful to them. Understanding infinity was also related to the depth of knowledge attributed to Ms. Smart, but only among the oldest children. Perhaps this is because understanding infinity must reach a more complete and qualitatively different level of sophistication before contributing to an understanding of omniscience. No children younger than 6.5 years understood all three components of infinity measured. In contrast, 25% of the oldest children (6.5 to 11 years) understood all three components, and these children ($M = 6.71$, $SD = 2.63$) were similar to adults ($M = 7.18$, $SD = 2.30$) in the depth of knowledge they

attributed to Ms. Smart. The remaining 6.5- to 11-year-olds (who understood just two, one, or none of the components of infinity) granted Ms. Smart a depth of knowledge ($M = 2.86$, $SD = 3.76$) similar to what 4.5- to 6.5-year-olds granted her ($M = 3.25$, $SD = 3.28$).

Results of prior studies have been taken as evidence of children's early understanding of mental infallibility or omniscience, even though that work does not directly examine children's understanding of infallibility or omniscience. The current studies reveal that, when studied directly, young children do not know much about all-knowingness, and are *unprepared* to entertain such a notion or to grant it, even to extraordinary beings. Instead, developing an understanding of omniscience is a protracted process beginning in early childhood and proceeding well into late childhood, and perhaps even adolescence and adulthood. Although young children in particular are quite conservative in the knowledge they attribute to extraordinary beings and often deny that all-knowing beings can really exist, they can entertain the idea of a being who possesses certain types of knowledge that most other people, including themselves, do not possess. Understanding the depth of such beings' knowledge is more difficult to grasp, and may not become intuitive until adolescence or early adulthood. Importantly, an understanding of omniscience does not develop in isolation but is influenced by socio-cultural input that children receive about beings with extraordinary minds, and is supported by the development of other cognitive capacities, including a developing ability to imagine the improbable and an understanding of limitlessness.

CHAPTER V

General Discussion and Conclusions

Children's understanding of the mind has been a topic of intense research over the past three decades (for reviews, see Flavell & Miller, 1998; Harris, 2006; Wellman, 2011). Most of this research has focused on the nature, precursors and consequences of children's developing understanding of ordinary, constrained human minds. However, children and adults learn about and believe in minds that are less constrained than the human mind; these include the minds of animals with exceptional perceptual abilities, fantastical characters with extraordinary mental powers, and omniscient religious figures. Understanding how children develop an understanding of extraordinary minds promises to provide a more comprehensive look at their understanding of minds in general. Such research can shed important light on children's developing understanding of the fundamental limitations of the human mind, which has important implications for how children interact with and learn from others. Successfully learning from others requires that children understand that some informants are more knowledgeable than others, that some informants are less knowledgeable than children themselves, and that there are certain things that ordinary people can never know (for reviews of this early development, see Gelman, 2009; Harris, 2007).

Moreover, research on children's understanding of extraordinary minds can help address crucial issues in the cognitive science of religion, including questions about how

prepared young children are to represent certain religious concepts, how culturally-provided religious concepts are assimilated and accommodated by children's cognitive architecture, and when and under what conditions children *believe* certain religious concepts. In the following sections, I briefly review prior studies on children's developing understanding of extraordinary minds, and again outline the two most prominent theories that have emerged from this research: the *anthropomorphism* and *preparedness* hypotheses. Next, I explain how the three studies in this dissertation help to reconcile prior conflicting findings as well as extend the literature in several important ways. Finally I provided some directions for future research in this area.

Prior Research, and the Preparedness and Anthropomorphism Hypotheses

A small body of research has begun to shed light on how children come to understand extraordinary minds. The earliest studies were inspired by Piagetian theory, and identified a general trend: older children entertain more abstract notions of God (e.g., Nye & Carlson, 1984). These early studies often lumped together all notions that children held about God—his physical presence, biological nature, mental abilities, and physical abilities—and so they reveal little about children's understanding of God's extraordinary mind in particular. Moreover, because conceptual development proceeds differently for different domains of knowledge (Gelman & Kalish, 1996; Wellman & Gelman, 1998), a developing understanding of extraordinary minds may proceed on a different timetable than developing understandings of other extraordinary capacities. Acknowledging these limitations and recognizing that children can entertain some abstract notions much earlier in development than Piaget proposed, Barrett and colleagues set out to examine just how early an understanding of mental infallibility emerges (Barrett, Richert, & Driesenga,

2001; Barrett & Richert, 2003; Knight, Sousa, Barrett, & Atran, 2004; Richert & Barrett, 2005). They administered to young children theory-of-mind (ToM) tasks for which a piece of information was obstructed or obscured (e.g., an object was in an unfamiliar closed container) and only the child and experimenter knew the information. Children reasoned whether God, ordinary humans, and other beings would hold that knowledge as well. Findings revealed that children attributed correct knowledge to God both before and after they started to report (at around 5-years of age) that ordinary humans (e.g., their mother) would lack such knowledge.

Drawing upon their findings, Barrett and colleagues forwarded a *preparedness* hypothesis, which states that very young children are prepared to understand all minds as infallible, and this makes them particularly capable of representing radically non-human, extraordinary minds, including the mind of the Judeo-Christian God: “on many properties, young children seem equipped with default assumptions that better match theological descriptions of God than adult conceptions of people” (Barrett & Richert, 2003, p. 309).

The preparedness hypothesis is intriguing, especially when teamed with research demonstrating that we have a host of other cognitive biases that predispose us to detect and believe in extraordinary beings, including biases to detect agency in the world, to see nature as purposeful, and to see the world, including people, as intentionally designed (Barrett, 2000; Boyer, 2003; Evans, 2000a; Guthrie, 1993; Kelemen, 2004). However, there are many problems with the preparedness hypothesis, both theoretical and empirical. One theoretical problem involves how adaptive it would be for children to think that everyone is all-knowing or mentally infallible, considering that children

interact daily with individuals who clearly are neither. Indeed, if it is somehow adaptive to believe that other people are all-knowing, why do young children begin to acknowledge others' mental limits so early in development? Later, I will discuss why it might be advantageous for children to recognize others' fallibilities from an early age.

Further theoretical issues become apparent when considering non-human and atypical ToM development. From a preparedness perspective, young preschoolers' over-attribution of their own knowledge to others on ToM tasks, for example false-belief tasks, is taken as evidence that children are prepared to understand infallible minds (e.g., Barrett et al., 2001; Barrett & Richert, 2003; Richert & Barrett, 2005). By 5-years, most children realize that people will hold false beliefs on these tasks (Wellman, Cross, & Watson, 2001), but some older children (and adults) continue to over-attribute knowledge to others on these tasks; notably, individuals who have autism spectrum disorders (Baron-Cohen, Leslie, & Frith, 1985; Peterson, Wellman, & Slaughter, in press). Using the logic of the preparedness hypothesis, these individuals should be particularly likely to find beings with infallible minds, like the Judeo-Christian God, appealing. Yet a recent study suggests that the exact opposite is true—individuals with autism spectrum disorders are more likely than typically-developing individuals to be *atheist* (Caldwell-Harris, Murphy, Velazquez, & McNamara, 2011). A similar problem with the preparedness hypothesis arises when the social-cognitive capacities of other species are considered. Recent research demonstrates that chimpanzees have some rudimentary understanding of the mind, but they typically fail false-belief tasks (for review, see Call & Tomasello, 2008). Would preparedness theorists argue then that chimpanzees (as well as other non-human

animals that have concepts of others' minds) are prepared to represent and believe in extraordinary, infallible beings?

The last theoretical problem with the preparedness hypothesis becomes apparent when considering children's concepts and naïve theories about other domains. The preparedness hypothesis holds that children's failure to acknowledge others' mental fallibilities reflects an understanding of (or at least a preparedness to understand) mental infallibility. In other words, not understanding particular constraints prepares children to understand phenomena that exceed those constraints. Consider what this logic (about children's understanding of psychology) would suggest if it is applied to other domains of thought? We might conclude that young children's difficulty conceptualizing time, teamed with an early difficulty conceptualizing space, prepares young children to understand Einstein's theory that space and time are relative.

In addition to the theoretical arguments against the preparedness hypothesis, empirical evidence is also needed. In advance of the studies presented here, two studies made initial strides in that direction (Giménez-Dasí, Guerrero, & Harris, 2005; Makris & Pnevmatikos, 2007). In these studies, preschoolers were given knowledge-ignorance and false-belief tasks where they reasoned about the epistemic states of ordinary humans and of God. In contrast to Barrett and colleagues' findings, Makris and Pnevmatikos (2007) found that 3- and 4-year-olds attributed ignorance not just to an ordinary human but also to God, and Giménez-Dasí and colleagues (2005) also found that 4-year-olds attributed false beliefs to God. Older children differentiated between humans' fallible mental states and God's less fallible mental states. Thus, these results undermine preparedness claims that for older children to represent God's mind they merely continue to apply their earlier

(3-year-old) default understanding of extraordinary minds. Rather, there may be developmental periods when children first attribute ordinary human limits to ordinary *and* extraordinary beings before appropriately attributing extraordinary capacities to extraordinary beings. These results thus support an alternative *anthropomorphism* hypothesis, which states, broadly, that children’s understanding of extraordinary minds emerges from an understanding of ordinary, anthropomorphic minds; not the other way around.

There are several variants of an anthropomorphism hypothesis (for different versions, see Barrett & Richert, 2003; Boyer, 1996; Piaget, 1969/1929). Perhaps the most popular version, taken from Piagetian theory, is that young children consider adults and God to possess many of the same psychological, biological, and physical properties: “Either God is a person or men are gods, or else God is the chief of men” (Piaget, 1969/1929, p. 382). Piaget himself, however, did not take a strong stance on whether children consider adults to be perfect (like God) or whether children initially consider God to be imperfect (like humans). The anthropomorphism hypothesis that I focus on here reflects the latter assumption—children’s God concepts build upon their understanding of ordinary humans—and is consistent with the reasoning that Makris and Pnevmatikos (2007) use to interpret their findings: “younger children are not better prepared to understand God’s mental properties than those of humans but rather that they tend to project systematically onto God the properties that each time they attribute to humans” (Makris & Pnevmatikos, 2007, p. 373).

What about the data showing that 3-year-olds over-attribute correct knowledge and beliefs to many agents on ToM tasks? Here we do not face conflicting results; all of

the studies reviewed have found this trend, and this tendency has long been acknowledged in the ToM literature (e.g., Wellman & Bartsch, 1988; Wimmer & Perner, 1983). Here we face conflicting *interpretations* with, as yet, no further data to distinguish them. From a preparedness perspective, these data represent young children's attribution of mental infallibility to all beings. From an anthropomorphism perspective, these data do not represent an understanding of mental infallibility, they represent a reality bias—the tendency for young children, who have little explicit knowledge of the mind, to answer questions about others' knowledge by simply referring to or reporting reality (or, what they themselves represent to be the actual state of affairs).

The studies of Barrett and colleagues on the one hand (Barrett et al., 2001; Knight et al., 2004; Richert & Barrett, 2005), and the studies of Giménez-Dasí et al. (2005) and of Makris and Pnevmatikos (2007) on the other hand leave us with two sets of contrasting findings, not to mention different sets of interpretations, apparently supporting two contradictory theories concerning children's emerging understanding of extraordinary minds. The three studies in this dissertation were designed to resolve these conflicting findings and interpretations as well as to extend prior work, by examining not just when children first begin to attribute privileged knowledge to extraordinary beings, but also by assessing the breadth and depth of knowledge that children of different ages (as well as adults) attribute to extraordinary beings. Moreover, these studies were designed to identify socio-cultural and cognitive factors that might facilitate a developing understanding of omniscience.

Resolving Discrepancies in Prior Findings

Discrepancies in prior findings may be products of several factors, notably differences in sampling techniques and differences in the tasks that children completed. The methods that I employed in Studies 1 and 2 attended to both of these factors. First, prior discrepancies may be products of sampling differences. Most studies have assessed developmental trends by splitting their samples into broad age groups—for example, a group of 3-year-olds, a group of 4-year-olds, and a group of children 5-years and older—with the intent of using the middle group (4-year-olds) as a test of the anthropomorphism versus preparedness hypotheses. The logic goes that, if 4-year-olds (who are often beginning to attribute false beliefs and ignorance to ordinary humans) also attribute mental fallibilities to God, then the preparedness hypothesis loses support. The problem with this sampling technique is that, in some populations, the initial understanding of certain ordinary mental limits (and thus the extension of mental limits to extraordinary beings) may occur during that pre-defined middle period (4-years of age), whereas in other populations it may not. Indeed, the average age at which children begin to acknowledge that ordinary people have certain mental fallibilities, for example false beliefs, may differ on the order of several months, or even close to a year between populations (Wellman, Cross, & Watson, 2001).

The fact that some studies do not find that children in this middle group attribute fallibilities to God could simply be because sampling techniques glossed-over this (potentially brief) developmental period. Studies 1 and 2 attended to this possibility by densely sampling children at an age when children in those particular populations began to attribute certain mental fallibilities to ordinary humans. The two mental fallibilities

that I focused on were ignorance and false-beliefs. Because children reach an understanding of ignorance before understanding false beliefs (Wellman & Liu, 2004), age groupings were appropriately different for the two tasks—the key middle groups were slightly younger for analyses using the knowledge-ignorance task.

Another potential reason why findings vary between prior studies is because different studies have used different ToM tasks. Barrett and colleagues typically used tasks in which children had access to the information they were asked about, and thus children were able to merely attribute their own knowledge (of reality) to others on these tasks. Makris and Pnevmatikos (2007) used one of Barrett et al.'s (2001) tasks, where children themselves possessed the critical knowledge, as well as a task for which children did *not* themselves have access to the key information. Using Barrett and colleagues' task, Makris and Pnevmatikos replicated Barrett and colleagues' results—children of all ages did not attribute ignorance to God; but when using the knowledge-ignorance task where children did *not* have access to the knowledge (so they were less subject to a reality bias), their 4-year-olds typically reported that all agents, including God, would *not* know the key information. These results may be a product of the different tasks used or they may be a function of the age-grouping and sampling issues discussed earlier, or they could be a product of both the tasks and age groupings.

Using the sampling methods discussed above, I employed tasks similar to those used by Barrett et al. (2001) to determine if their findings were simply artifacts of the tasks that they used or if their results can be better explained by the sampling issues discussed earlier. In both Studies 1 and 2, I found that children in the key middle age groups, who were just beginning to attribute ignorance or false beliefs to ordinary

humans, also attributed those same fallibilities to God. This was the case for children attending secular schools (Study 1) as well as for children who attended religious schools and were particularly knowledgeable about God (Study 2). Moreover, I was able to replicate the developmental trends reported by Barrett and colleagues—when I split my Study 1 sample equally into thirds (glossing over the periods when children developed initial understandings of the two fallibilities), none of the resulting age groups extended mental fallibilities to God. Thus it seems that Barrett and colleagues’ results are largely a function of their sampling techniques. Conceivably though, the periods when children extend fallibilities to extraordinary beings may be lengthier and easier to capture with tasks where very young children cannot simply use reality to guide their mental inferences. This may explain how others have found these periods of over-extension with broader age-groupings—for Makris and Pnevmatikos’ (2007) traditional knowledge-ignorance task and for half of Giminez-Dasi’s et al.’s (2005) task, children were not aware of reality and could not attribute their own knowledge to other beings.

Beyond the two factors discussed above (different tasks and sampling methods) an additional reason for the discrepancies in prior research could be that children from different backgrounds attribute different abilities to God. In these tasks, there are conceivably several reasons why children would attribute to God privileged knowledge. The first is a reality bias, discussed briefly above; for these tasks, children could simply use reality to guide their inferences about others’ knowledge. But, as also discussed, this would not indicate that children understood that anything was extraordinary about God’s capacities. Alternatively, if they had learned about God’s perceptual powers, they may attribute knowledge to God because of his exceptional perceptual capacities (e.g., an

ability to see through the box); this is indeed extraordinary but it does not reflect *mental* infallibility per se. Lastly, children may have learned about God's extraordinary mind and so appreciated that God could possess knowledge by virtue of his mind and without the use of a sense like vision. To examine what extraordinary capacities (if any) young children grasp, I used two techniques in Studies 1 and 2: (1) children reasoned about the knowledge held by agents with different capacities (ordinary humans, a superhero and a cat with special vision, and Mr. Smart who "knows everything" but does not have special perception), and (2) children explained *why* each agent would possess knowledge.

The youngest children in both Studies 1 and 2 (3-year-olds) attributed "correct" knowledge to all beings but their reasons for doing so were either uninformative (e.g., "I don't know", "Because") or reflected a reality bias ("Because I know", "That's what's inside the box"). These young children rarely mentioned agents' perceptual *or* mental abilities. Thus, it is not clear if 3-year-olds were actually considering the contents of different beings' minds or if they were just citing reality for these tasks. Indeed, even when children were taught that Mr. Smart "is very smart, he knows everything", they very rarely mention that in their reasoning—information about Mr. Smart's mind did not seem relevant to the 3-year-olds. Four-year olds often attributed accurate knowledge to the superhero and to the cat, and explained that they would acquire their knowledge through their exceptional *perception*; however 4-year-olds did not use this reasoning for the other agents.

In addition to referring to the special perception of the superhero and the cat, 5-year-olds explained that God will know the contents of the container because of his extraordinary mind or perception, and explained that Mr. Smart will know the contents of

the container because of his extraordinary mind. Thus, how 3-year-olds and 5-year-olds reasoned about extraordinary beings' minds is quite different. These reasoning data provide additional support for an anthropomorphism hypothesis—an understanding of extraordinary minds is not simply continuous across the preschool years, as proposed by the preparedness hypothesis (Barrett & Richert, 2003; Richert & Barrett, 2005).

Extending Beyond the Paradigms of Prior Research

Studies 1 and 2 shed light on how children reach an initial understanding of extraordinary mental capacities. However, these studies, as well as most prior work, have been limited in several ways. The knowledge that children attributed to extraordinary beings in prior studies is often knowledge that children themselves possess. Moreover, the knowledge is typically about accessible (though somewhat obstructed) facts about the here-and-now (e.g., the contents of closed boxes, or the content of drawings that are placed at a distance). Five-year-olds' understandings that extraordinary beings can possess such knowledge is impressive, but this is far from understanding infallibility or omniscience. Omniscience is knowledge of *everything* about *everything*, not just knowledge that children possess and not just knowledge about the immediate, proximate, and tangible. Using a new set of tasks, Study 3 more comprehensively examined the types (or breadth) of knowledge that children and adults attributed to an extraordinary being as well as the amount (or depth) of knowledge that participants granted to that extraordinary being. Moreover, developmental trends were examined beyond the preschool years—Study 3 additionally included elementary-school children and adults.

To examine the breadth of knowledge that participants attributed to an all-knowing being, they were first taught about Ms. Smart, who knows “everything about

everything,” and they were asked whether she possessed several types of knowledge, including knowledge of non-personal facts about the past, present, and future, as well as personal information about people. In contrast to adults, who attributed all forms of knowledge to Ms. Smart, children, especially preschoolers were conservative in the breadth of knowledge that they attribute to Ms. Smart. Children often denied Ms. Smart knowledge of other people (their thoughts and preferences) and non-personal facts about the past and future. Moreover, preschoolers very rarely attributed all forms of knowledge to Ms. Smart. Thus, far from being an idea that children are prepared to grasp, an understanding that beings possess these and all other types of knowledge is not intuitive to children, even by the elementary-school years.

However, when provided additional evidence and instruction about Ms. Smart’s extraordinary mind—including information about her “very, very special brain”, and corrective feedback about her knowledge of “everything about everything”—3- to 4.5-year-olds granted her a broad body of knowledge, including knowledge about the future and some personal knowledge of other people (their thoughts and preferences). Moreover, and critically, these children attributed a broader set of knowledge to Ms. Smart than they attributed to an ordinary person—their mothers. Yet even with this rich instruction about Ms. Smart’s mind, 3- to 4.5-year-olds were more conservative than older children and adults in their attributions of knowledge about the past and about other people to Ms. Smart, especially knowledge of others’ behavior and personal events. Moreover, only a minority of 3- to 4.5-year-olds attributed to Ms. Smart *all* forms of knowledge that they were asked about. In contrast, when provided this more elaborated introduction about her extraordinary mind, older children (4.5-years and older) attributed

each form of knowledge to Ms. Smart. Developmental shifts in understanding of Ms. Smart's capacities were also evident in participants' *reasoning* about her knowledge. When reasoning about *how* Ms. Smart would possess this knowledge, there was a steady age-graded increase in participants' reference to Ms. Smart's extraordinary mind; with preschoolers rarely using this reasoning and adults typically using this reasoning. Older children's understanding of Ms. Smart's breadth of knowledge was significantly correlated with their ability to imagine improbable phenomena, suggesting that this capacity may support a developing understanding of omniscience.

Another novel component of Study 3 was an assessment of the extent to which participants understood the *depth* of extraordinary beings' knowledge. This was done by having participants decide who was more knowledgeable about certain domain-specific information, Ms. Smart or an expert on that domain. If participants understood that an extraordinary being can know *everything* within a domain, they should have always reported that Ms. Smart knows more than the expert. However, the exact opposite was true of 3- to 4.5-year-olds—they typically reported that the *experts* know more.

Elementary-school children performed better on this task but still not as well as adults, who typically reported that Ms. Smart knows more than the experts. This developmental pattern held true even when participants were given the elaborated introduction and corrective feedback about Ms. Smart's knowledge. In sum, grasping the depth of an all-knowing being's knowledge is particularly difficult, even with extensive training, and it is certainly not something that young children are prepared to understand. However, there is evidence that older children can grasp this idea if other, supporting, cognitive competencies are in place. Among the oldest participants, those whose understanding of

infinity was on-par with adults were also similar to adults in the depth of knowledge they attributed to Ms. Smart.

The Role of Socio-Cultural Input in Facilitating an Understanding of Extraordinary Minds

Concepts of extraordinary minds do not develop in a vacuum. Much as a developing understanding of ordinary minds is contingent upon social interaction, including conversations about the mind (Carpendale & Lewis, 2004), an understanding of extraordinary minds might also be contingent upon socio-cultural input, specifically exposure to ideas about extraordinary beings. The only researchers to consider this were Giménez-Dasí et al. (2005), who found trends suggesting that religiously-schooled children better understood God's extraordinary mental capacities, but this trend was not statistically significant and the study lacked statistical power to answer this question. Studies 2 and 3 specifically considered the socio-cultural input that children receive about beings with extraordinary mental abilities, namely the Judeo-Christian God.

The role of socio-cultural input in facilitating an understanding of extraordinary minds was assessed in several ways. First, preschoolers who attended secular preschools (Study 1) were directly compared to preschoolers from religious preschools (Study 2), who engaged in more activities involving ideas about God, and whose parents reported that it was more important for them to know about God. Children in both samples went through a developmental period (at around 4-years of age) during which they attributed fallible mental states (false beliefs and ignorance) to God, consistent with an anthropomorphism hypothesis. However, intriguingly, in comparison to secularly-schooled children from Study 1, religiously-schooled children from Study 2 did not go

through this developmental period when reasoning about Ms. Smart, whom children were just taught “knows everything.” Thus, although children at this age may not intuitively think of familiar beings (like the Judeo-Christian God) as possessing extraordinary mental abilities, cultural input about God’s powers facilitated their ability to apply this understanding to a new being when that being’s powers were called to the forefront of children’s minds—children were instructed and reminded about Mr. Smart’s mind but experimenters told them nothing about God.

Another way that I examined the role of socio-cultural input was by assessing relations between children’s knowledge of extraordinary beings and their understanding of extraordinary minds. Combining data across samples from Studies 1 and 2, I assessed relations between children’s knowledge of God and their attributions of mental states to God, Mr. Smart and Heroman (a superhero who has x-ray vision). Children’s knowledge of God was related to attributions of correct mental states to all three agents; however, this was true only among children who simultaneously attributed ignorance and false-beliefs to ordinary humans on the same tasks—children who had acquired a representational ToM. Among younger preschoolers, children’s knowledge of God was unrelated to children’s attributions of mental states to extraordinary beings. Likewise, in Study 3, children who engaged in more activities involving ideas of God and children who attended a place of worship more often attributed a broader set of knowledge to Ms. Smart. But again, this was true only among children who had acquired a representational ToM (4.5- to 6.5-year-olds), not younger children.

The fact that socio-cultural input predicted advanced understanding of extraordinary minds, but only among children who understood certain limits of ordinary

human minds, is consistent with other research demonstrating that the force of socio-cultural experience on social-cognitive development varies along with children's level of development. For example, the presence of older siblings facilitates a more advanced understanding of ordinary minds (specifically, false-belief understanding), but only among older preschoolers, not younger children (Ruffman, Perner, Naito, Parkin, & Clements, 1998). My findings, as well as those of Ruffman and colleagues, are consistent with modern theories of conceptual development, which hold that the extent to which new information fosters conceptual change is a function of one's existing cognitive architecture (Gopnik & Wellman, 1994; Wellman & Gelman, 1998). These results are also consistent with Sperber's (1990, 1996) reasoning that the successful cultural transmission of representations is a function of the cultural representations that individuals already hold. There is something about the period shortly after children develop a representational ToM that makes them particularly receptive to culturally-provided information about extraordinary minds.

Developmental Story Told by the Current Studies

Collectively, the studies in this dissertation reveal an intriguing story about children's developing understanding of extraordinary minds. This is not a story of a general age-graded increase in children's abstract reasoning about God, as might be predicted from Piagetian theory (Piaget, 1969/1929). Moreover, it is not a nativist story of children intuitively understanding extraordinary mental capacities, as might be concluded from a preparedness perspective (Barrett & Richert, 2003; Richert & Barrett, 2005). The actual story, which I have started to uncover here, is more nuanced and

multifaceted, and accords more with our current knowledge of children's conceptual development.

Children's earliest understanding of the mind is an understanding of an anthropomorphic mind. This is important, as the vast majority of the minds that children need to contemplate, interact with, and learn from are the minds of ordinary, fallible people. From a very young age, children acknowledge certain limits of people. Older infants and toddlers realize that people are imperfect producers of information; they will spontaneously deny and correct others (even adults) who make statements that are clearly false (Koenig & Echols, 2003; Pea, 1982). This early skepticism is arguably adaptive in several regards. First, falsely assuming that others are infallible might limit children's motivation to interact with and learn from their environment first-hand. Second, because the information that others provide is frequently unreliable (because of informants' ignorance, mis-statements, pretence, or deceptiveness), if children were to accept everything they heard as true, their knowledge base would become "alarmingly unstable" (Perner, 1988, p. 145).

However, at this young age, children do over-estimate others' knowledge—in particular, they are prone to attribute their own knowledge to others (Birch & Bloom, 2003; Wellman & Bartsch, 1988). I have referred to this early tendency as a *reality bias*, and have noted that this tendency is not specific to children—even adults over-attribute their own knowledge to others in certain situations (Birch & Bloom, 2004; Nickerson, 1999)—and this tendency is also not specific to humans (Call & Tomasello, 2008). This tendency should not be taken as evidence that children think that others are infallible or omniscient—omniscience is much more than a being knowing what others know.

Further, and importantly, there is also no evidence that this early tendency is necessary for children to initially understand certain extraordinary mental capacities. Indeed, consistent with the findings of others (Giménez-Dasí et al., 2005; Makris & Pnevmatikos, 2007), in Studies 1 and 2, 5-year-olds understood that God holds privileged knowledge, even though children just months younger had *not* granted that knowledge to God. This demonstrates that there is no *need* to be “prepared” to understand mental infallibility in order to develop an initial understanding of extraordinary minds (for a similar argument, see Rottman & Kelemen, in press). Not only do older preschoolers understand that a familiar being, like God, possesses privileged knowledge, but if they receive detailed information about a new being with an extraordinary mind older preschoolers report that he too possesses privileged knowledge and children *explain* that it is because of his mind.

The current studies reveal that the knowledge young children attribute to extraordinary beings is not limited to information that children know or even to easily-accessible information about the here-and-now. If provided *extensive* information and training about a being’s extraordinary mind, preschoolers attribute to that being a broad set of knowledge, including knowledge of non-personal facts about the past and present, as well as some personal information (e.g., knowledge of others’ actions and thoughts). Importantly, young children attribute this knowledge to extraordinary beings while appropriately denying that knowledge to familiar adults. This early understanding of extraordinary knowledge may reflect children’s use of a heuristic: if X is something to be known, and if the agent is “all-knowing”, then the agent knows X. Though apparently simple, this heuristic is not consistently applied until about 5- or 6-years of age. In contrast, young preschoolers tend to deny certain forms of personal information to

extraordinary beings, even if they are taught that the being “knows everything about everything.”

Once children have acquired a representational ToM and have begun to acknowledge certain limits of the human mind, such as ignorance and false beliefs, socio-cultural input can play an important role in children’s understanding of the types of knowledge that extraordinary beings possess. Older preschoolers who are regularly exposed to ideas about the Judeo-Christian God, an omniscient being, attribute to other all-knowing beings extraordinary knowledge at an earlier age than children with less exposure to God concepts. Moreover, older preschoolers with greater exposure to ideas about God attribute to other “all knowing” beings a broader *set* of knowledge. This facilitation may be a product of frequent messages that some children receive about the types of knowledge that God possesses (e.g., knowledge of people’s beliefs, intentions, and behavior). Children can then apply this understanding to new beings with extraordinary minds.

How beings *acquire* their knowledge factors strongly in how children reason about their knowledge base. If a being has mechanisms that can be used to acquire certain knowledge, children find it easier to grasp that the being will possess that knowledge. For example, 4-year-olds understand that beings with exceptional perception (e.g., superheroes with x-ray vision) can acquire knowledge that would be visually obstructed to ordinary people; and children understand this before understanding that an all-knowing being can possess the same knowledge without the use of perception (Lane et al., 2010). Children also spontaneously create means through which extraordinary beings acquire knowledge, and young children who believe that all-knowing beings exist commonly

explain that such beings acquire their knowledge through ordinary media, first-hand experience, and social interaction. Thus, when children seriously consider how a being could possess information that would be difficult (or impossible) for ordinary people to possess, a typical first solution is that such beings use ordinary means to collect information. Assuming that extraordinary beings are using these mechanisms makes the idea of *all-knowingness* less counterintuitive and easier for children to cognitively represent. Older children and adults do not need to assume that an extraordinary being's knowledge hinges upon ordinary mechanisms; for them the fact that a being "knows everything about everything" is reason enough to attribute many (perhaps all) forms of knowledge to that being. An emerging ability to imagine beings who can acquire extraordinary knowledge without the use of ordinary mechanisms may be reflected in positive relations found between older children's ability to imagine the improbable and the breadth of knowledge they attribute to all-knowing beings.

Thus, by 5- or 6-years of age, children can attribute a wide variety of knowledge to extraordinary beings, including knowledge that children and most other people do not and cannot possess. However, understanding omniscience is more than attributing many forms of knowledge to a being. Another important aspect of omniscience is the *depth* of an all-knowing being's knowledge. An omniscient being knows *everything* about every topic or domain, and thus an omniscient being's knowledge about a domain exceeds even experts' knowledge. This is something that children have particular difficulty grasping. When asked whether an all-knowing being or an expert holds more knowledge within the expert's domain, preschoolers overwhelmingly report that the expert is more knowledgeable. Elementary-school children perform better than preschoolers but are still

not on par with adults, who firmly understand that the all-knowing being will *always* possess more knowledge in a domain. Understanding the depth of extraordinary beings' knowledge may be facilitated by a more general ability to conceptualize extremely large amounts or to grasp the idea of limitlessness. Older children with an advanced understanding of infinity (which may rely on conceptualizing extremely large amounts and on conceptualizing limitlessness) have a more adult-like understanding of extraordinary beings' depth of knowledge.

Thus, children can begin to represent some concepts of extraordinary minds during the preschool years; however, this understanding is initially limited. Although some preschoolers may report that they know someone who knows everything or may report that it is possible for someone to know everything, an understanding of what it means to "know everything" is quite narrow in the preschool years and is certainly not what comes to mind when adults contemplate beings who know everything. Moreover, children who claim that all-knowing beings exist typically grant those beings relatively ordinary knowledge (about objects, places, and people) and explain that their knowledge is *acquired* through ordinary (human-like) means (e.g., through common media, first-hand experience, and interactions with others).

Future Directions

We know much more now about how children develop an understanding of extraordinary minds. Yet the developmental story told by the studies in this dissertation is far from complete. Moreover, the data presented here raise several new questions that warrant future empirical attention. Both Studies 2 and 3 suggest that socio-cultural input plays an important role in children's initial understanding of extraordinary minds;

exposure to ideas about beings with extraordinary mental capacities, in this case the Judeo-Christian God, appears to facilitate children's understanding of other extraordinary beings' knowledge. All of these studies, however, were conducted in the United States, where ideas about extraordinary religious deities are commonplace, and thus even children who had not been exposed to religious concepts by their parents or teachers might have still been exposed to these concepts via the mass media or through their friends. Using the methods employed in these studies, it would certainly be interesting to see if the development of these concepts is delayed or more seriously compromised in cultures where such concepts are not as prominent.

The current data also suggest another interesting role of culture in the development and application of these concepts. In Study 3B, older children's (6.5- to 11-year-olds') exposure to ideas about the Judeo-Christian God was *negatively* related to their attributions of knowledge to Ms. Smart. Though these correlations were not statistically significant, they are supported by the results of another, ongoing, study that uses the same methods as those from Study 3B. In this ongoing study, children were recruited from an elementary school with a predominately Muslim population, located in a community in which concepts of the Judeo-Christian God are prominent and strongly endorsed. Compared to elementary-school children in Study 3B, these children attributed fewer types of knowledge to Ms. Smart (a more limited breadth of knowledge) as well as greater knowledge to experts than to Ms. Smart (a more limited depth of knowledge). Thus, at a certain point in development, once children appreciate what it means for a being to possess particular knowledge, they may resist attributing that knowledge to extraordinary beings if they are raised with the notion that such knowledge is exclusive to

God. These results are preliminary but indicate that it is worth considering both facilitation and suppression effects in future studies that explore the influence of socio-cultural input on an emerging understanding of extraordinary minds.

So far, studies on the topic of children's developing concepts of extraordinary minds have examined the types, quality, and depth of knowledge that children attribute to all-knowing beings. Yet the mind is more than a container of knowledge; the mind is active. Ordinary people have certain mechanisms through which they *acquire* knowledge—for example, by asking others or by perceiving things first-hand—and they can *use* that knowledge to plan their behavior, to make predictions, and so on. From Study 1, we know that children more easily grasp that a being possesses privileged knowledge if that being has exceptional *mechanisms* allowing him to perceive that knowledge, for example x-ray vision. From Study 3, we know that children spontaneously create ordinary mechanisms through which extraordinary beings acquire knowledge (e.g., by perceiving it first-hand or by asking someone). Indeed, young children who report that someone can know “everything about everything” often explain that the person or being will *acquire* their knowledge through ordinary mechanisms (e.g., books, television, or conversation). In contrast, adults are more comfortable concluding that a being has privileged knowledge simply because he “knows everything about everything.” This developmental shift—from assuming that there are mechanisms that all beings use to acquire knowledge to entertaining the notion that an extraordinary being can possess knowledge without using any mechanism—seems to be an important one, and deserves further empirical attention. There are several ways to systematically study this development. For example, children can be asked to reason about the knowledge held

by an all-knowing being that is blind or to reason about the knowledge held by an all-knowing baby, who has limited experience with the world.

The mind does not just acquire and store information. The mind also uses that information to affect the world—to perform physical actions (e.g., to write a book), to influence others' actions (e.g., to get others to read your book), and to influence others' thoughts (e.g., to convince others that you are a good writer). Ordinary humans are limited in the extent to which they can affect the world with their minds alone—we cannot move objects with our minds (we need bodies), we cannot communicate with our minds alone (we need to use overt signals), and we cannot change others' minds simply because we will it. This is not the case for a being with an all-powerful mind, which would be able to do all of these things. Future studies should examine not just what knowledge children attribute to beings with extraordinary minds but also what types of extraordinary outcomes such beings can produce with their minds.

Finally, it is important to know what cognitive architecture is necessary to support a developing understanding of extraordinary minds. As a start, in Study 3B I identified two capacities—an ability to imagine the improbable and an understanding of infinity or limitlessness—which were strongly related to knowledge that older children attributed to an all-knowing being. A central premise that I and others (e.g., Evans & Wellman, 2006; Makris & Pnevmatikos, 2007) have advanced is that children's understanding of extraordinary minds stems from their understanding of ordinary minds. Thus future studies can make use of scales that have recently been developed to gauge ToM development during the preschool and elementary-school years (Peterson, Wellman, & Slaughter, in press) to see how this relates to children's performance on the

extraordinary-minds tasks employed in these studies. Future studies should also consider how capacities that contribute to children's understanding of ordinary minds—including executive functions and language (Astington, 2004; Carlson & Moses, 2001; Cutting & Dunn, 1999; Sabbagh, Xu, Carlson, Moses, & Lee, 2006)—might also contribute to children's understanding of extraordinary minds.

In conclusion, young children are clearly not prepared to understand extraordinary minds, but the ability to do so *begins* to emerge relatively early, by the late preschool years. However, acquiring a full-fledged understanding of omniscience is a protracted developmental process that takes place through late childhood and perhaps through adolescence and early adulthood. This development is a gradual process of overturning intuitions about the capacities and constraints of the mind; a process facilitated by socio-cultural input that children receive about extraordinary beings, and supported by the development of several other cognitive competencies.

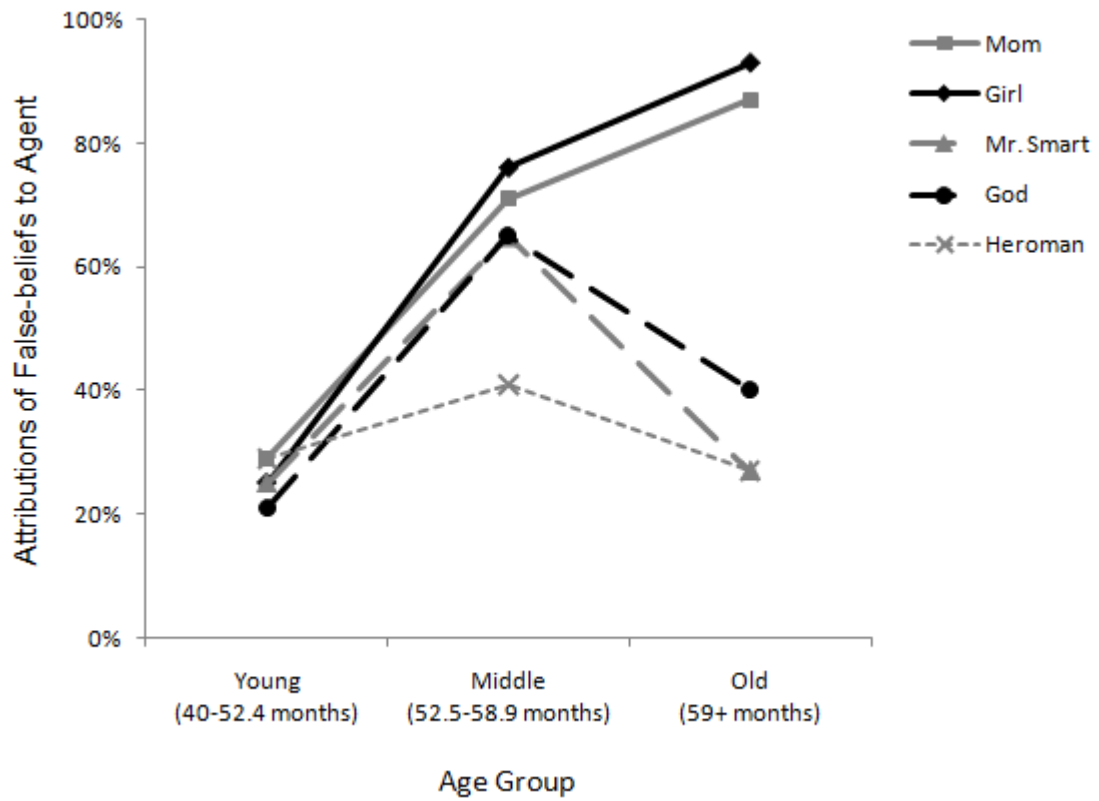


Figure 1-1. Study 1: Percentage of children, by age group, reporting that the protagonist will hold a false belief (i.e., will think there are crayons in the crayon box).

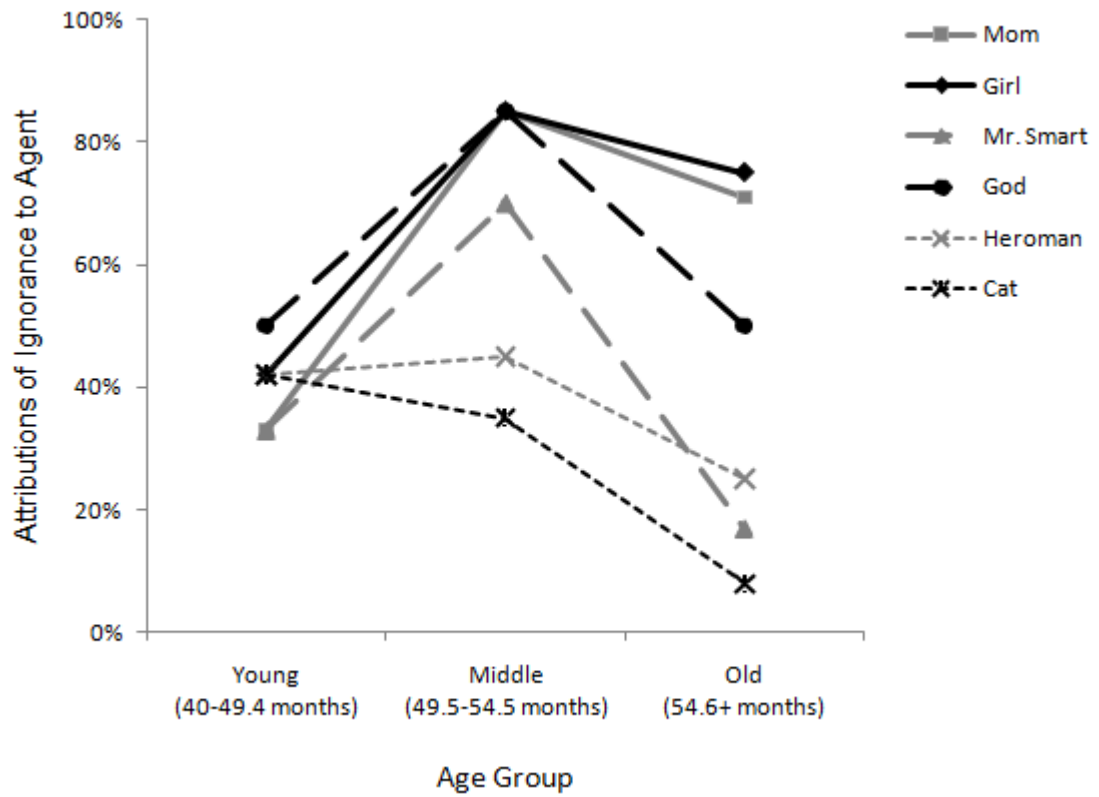


Figure 1-2. Study 1: Percentage of children, by age group, reporting that the protagonist will not perceive the contents of the unlit box (i.e., will think that the unlit box is empty).

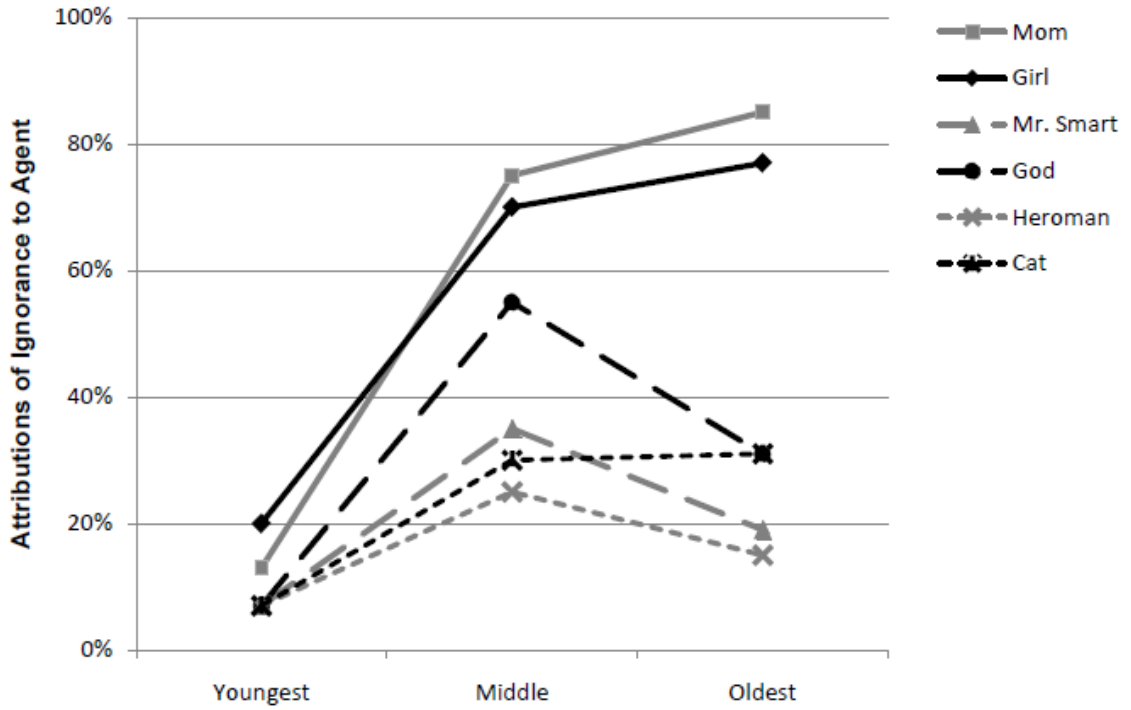


Figure 2-1. Study 2: Percentage of children, by age group, reporting that the protagonist will be ignorant about as to the contents of the unlit box (i.e., will think that the unlit box has nothing inside).

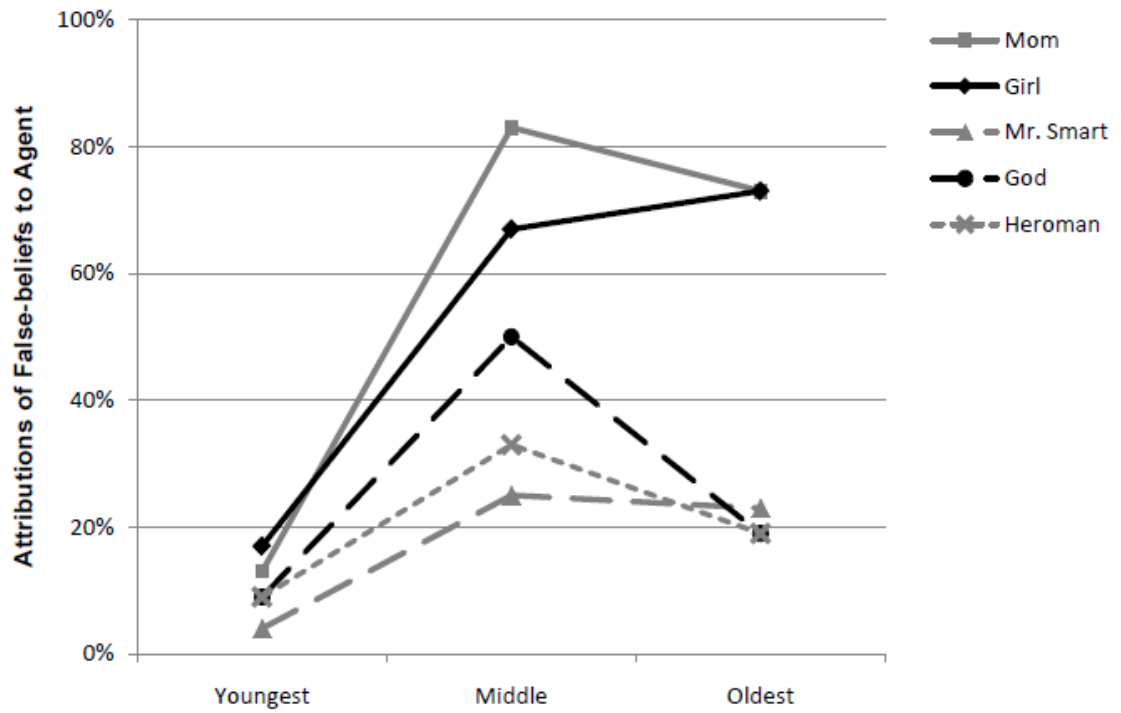


Figure 2-2. Study 2: Percentage of children, by age group, reporting that the protagonist will hold a false belief (i.e., will think that there are crayons in the box).

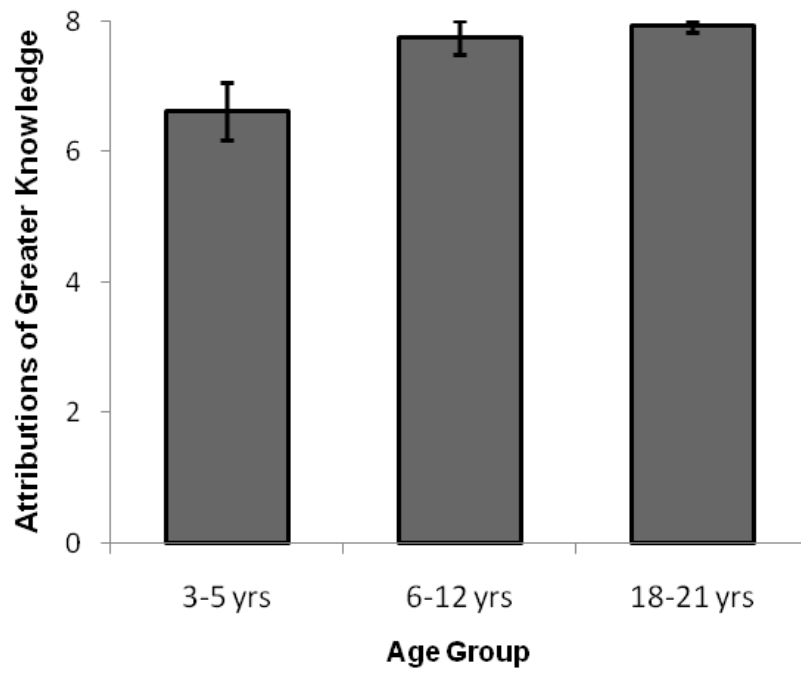


Figure 3-1. Study 3A: Mean attributions of greater knowledge to Ms. Smart, for information outside of experts' domains of expertise. Participants could earn a maximum score of 8. Error bars represent standard errors of the mean.

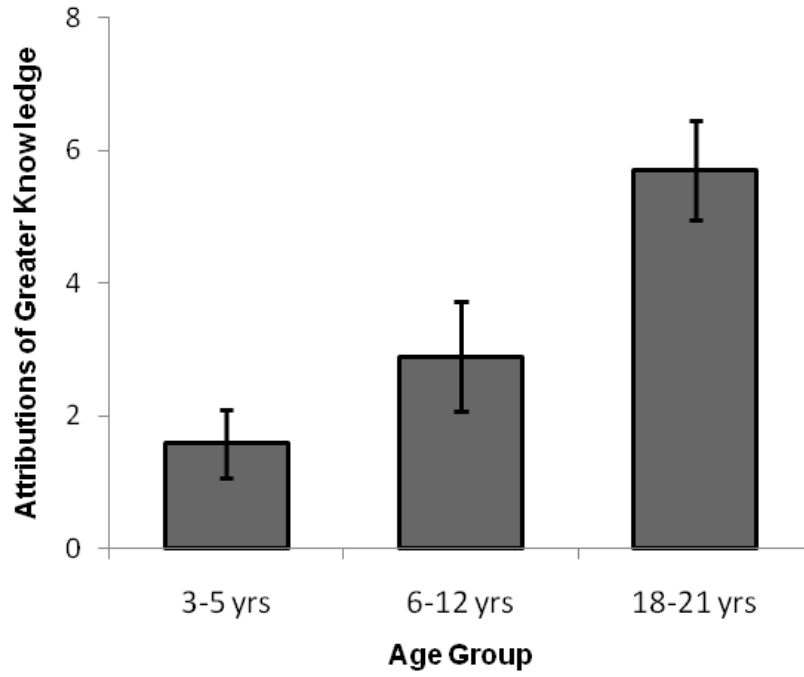


Figure 3-2. Study 3A: Mean attributions of greater knowledge to Ms. Smart, for information within experts' domains of expertise. Participants could earn a maximum score of 8. Error bars represent standard errors of the mean.

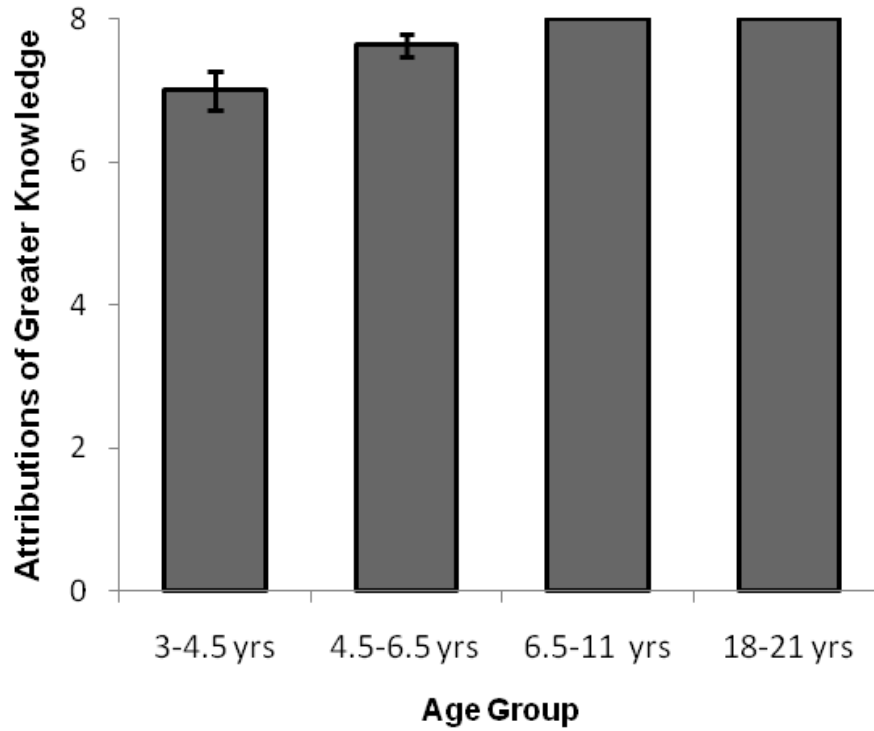


Figure 3-3. Study 3B: Mean attributions of greater knowledge to Ms. Smart, for information outside of experts' domains of expertise. Participants could earn a maximum score of 8. Error bars represent standard errors of the mean.

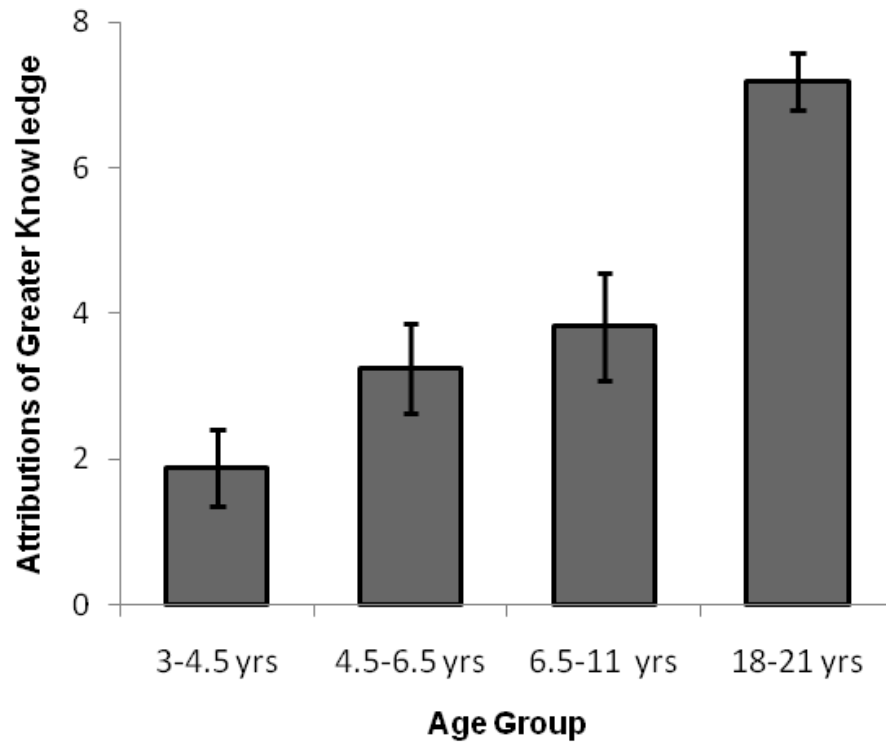


Figure 3-4. Study 3B: Mean attributions of greater knowledge to Ms. Smart, for information within experts' domains of expertise. Participants could earn a maximum score of 8. Error bars represent standard errors of the mean.

Table 1-1

Study 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.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 1-2

Study 1: 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"
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"

Table 1-2

Study 1: Coding of Open-ended Responses

Category	Description	Examples	
		False-Belief Task	Knowledge-Ignorance Task
Inadequate Mental Capacities	Child cites agent's inadequate mental capacities without referring to perceptual capacities	<p>"He doesn't know crayons are in there"</p> <p>"He doesn't know"</p>	<p>"He's not as smart as Smarty"</p> <p>"She won't know there's a frog inside"</p>

Table 1-3

Study 1: Reasoning Used to Explain Agents' 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.

Table 1-4

Study 1: 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.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2-1

Study 2: Coding of Open-ended Responses

Category	Description	Examples	
		Knowledge-Ignorance Task	False-Belief Task
Reality-based	Cites actual contents of container without mentioning agent's mental or perceptual capacities	"There is a frog" "Someone put it in there"	"There are marbles inside the box" "The crayons are in the bag"
Appearance-based	Cites the appearance of the box	"It's dark" "It's very dark"	"It has crayons on it" "There's a sign with crayons"
Typicality-based	Cites the type of container or mentions what that type of container typically holds	"It's supposed to be in there" "It belongs in there"	"It's a crayon box" "They belong in there"
Inadequate Perceptual Capacities	Cites agent's inadequate senses (e.g., inadequate vision)	"It's too dark to see inside" "He can't see all the way down"	"She can't see what's inside" "Someone can't see there"
Exceptional Perceptual Capacities	Cites agent's exceptional senses (e.g., vision, hearing)	"He can see in the dark" "He can see through everything"	"He can see through the box" "He can look through stuff"
Extraordinary Mental Capacities	Cites agent's mental capacities without referring to perceptual capacities	"He's very smart" "He's a good rememberer"	"He's super smart" "He knows a lot"
Adequate Perceptual or Mental Capacities	Explains that the agent will perceive or know the contents of container without referencing extraordinary abilities	"Because he saw it" "He'll see a frog" "She knows a frog's in there"	"He'll see marbles" "She looked in there" "Because she knows"

Table 2-1

Study 2: Coding of Open-ended Responses

Category	Description	Examples	
		Knowledge-Ignorance Task	False-Belief Task
Powerful	Cites the agent’s general powerfulness without referencing specific perceptual or mental abilities.	“He has every kind of powers” “He has lots of power”	“He’s powerful and he’s great” “He has powers”
Creator	Reports that the agent designed or created the focal stimuli.	“He made animals”	“He made marbles” “He made them and put them in the crayon box; and he made the box”
Want/Desire-based	Explains how agent’s knowledge or beliefs were driven by desires or preferences	“He wanted to play with it” “He wants to give it to another person for a pet”	“She likes marbles” “Boys love to play with toys” “She wants to play with them”

Table 2-2

Study 2: Reasoning used to Explain Agents' Correct Knowledge and Beliefs

Reasoning	Correct Knowledge			Correct Beliefs		
	<i>M</i> age	(SE)	<i>n</i>	<i>M</i> age	(SE)	<i>n</i>
Uninformative	51.43	(2.53)	14	52.12	(2.14)	17
Reality	52.70	(2.51)	8	52.53	(2.04)	14
Adequate Perception or Adequate Mental	56.83	(3.05)	10	58.02	(3.60)	8
Exceptional Perception	60.80	(1.03)	27	60.87	(1.28)	26
Extraordinary Mental	60.54	(1.24)	24	60.79	(1.21)	25

Note. *n* = Number of children who used reasoning category at least once to account for the correct knowledge or beliefs of Heroman, Mr. Smart, or God

Table 3-1

Study 3A: Attributions of Knowledge to Ms. Smart

Does Ms. Smart Know...	3 - 5 years	6 - 12 years	18 - 21 years
Where to find the tallest tree in the world?	84% **	90% ***	100% ***
What the first dog looked like long ago?	68%	74% †	88% ***
Who will win the Super Bowl next year?	68%	68%	88% ***
When your birthday is?	56%	84% **	92% ***
What your favorite food is?	47%	79% *	92% ***
What you're thinking right now?	32%	63%	91% ***
All six of the above items	16% ***	63%	83% **

Note. Asterisks indicate knowledge that was attributed to Ms. Smart at levels significantly different from chance (50%), according to binomial tests.

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 3-2

Study 3B: Attributions of Knowledge to Ms. Smart

Does Ms. Smart Know...	3 - 5 years	6 - 12 years	18 - 21 years
Where to find the tallest tree in the world?	76% **	92% ***	97% ***
What the first dog looked like long ago?	80% ***	86% ***	91% ***
When your birthday is?	83% *** ^a	81% ***	94% ***
What your favorite food is?	90% *** ^c	86% ***	91% ***
What you're thinking right now?	80% *** ^c	81% ***	88% ***
All five of the above items	61% ^c	75% **	85% ***

Note. These five items were asked of participants in both Study 3A and Study 3B. Asterisks indicate knowledge that was attributed to Ms. Smart at levels significantly above chance (50%), according to binomial tests.

Superscript letters indicate significantly greater attributions of knowledge to Ms. Smart in Study 3B compared to Study 3A, according to Z tests. Participants in Study 3B (3 - 5 years: $n = 41$; 6 - 12 years: $n = 36$; 18 - 21 years: $n = 34$) were matched on age to those from Study 3A.

* $p < .05$, ** $p < .01$, *** $p < .001$

^a $p < .05$, ^b $p < .01$, ^c $p < .001$

Table 3-3

Study 3B: Attributions of Knowledge to Mom for Both Items in Category

Category	3 - 4.5 years	4.5 - 6.5 years	6.5 - 11 years	18 - 21 years
Past	36%	7%	0%	0%
Present	32%	4%	18%	6%
Future	46%	4%	0%	0%
Personal Events	68% †	86% ***	100% ***	100% ***
Personal Actions	39%	21%	4%	0%
Personal Thoughts	50%	11%	4%	0%
Personal Preferences	75% *	71% *	71% *	88% ***
All seven of the above categories	14%	4%	0%	0%

Note. Asterisks indicate knowledge that was attributed to Mom by significantly more than 50% of the sample, according to binomial tests.

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 3-4

Study 3B: Attributions of Knowledge to Ms. Smart for Both Items in Category

Category	3 - 4.5 years	4.5 - 6.5 years	6.5 - 11 years	18 - 21 years
Past	61% ^a	79% ^{**c}	86% ^{***c}	91% ^{***c}
Present	71% ^{*c}	79% ^{**c}	93% ^{***c}	97% ^{***c}
Future	75% ^{*b}	86% ^{***c}	75% ^{*c}	88% ^{***c}
Personal Events	61%	86% ^{***}	79% ^{**}	91% ^{***}
Personal Actions	54%	86% ^{***c}	82% ^{***c}	88% ^{***c}
Personal Thoughts	75% ^{*a}	79% ^{**c}	71% ^{*c}	85% ^{***c}
Personal Preferences	82% ^{***}	89% ^{***}	82% ^{***}	88% ^{***}
All seven of the above categories	29% ^{*a}	64% ^c	71% ^{*c}	85% ^{***c}

Note. Asterisks indicate knowledge that was attributed to Ms. Smart by significantly more or less than 50% of the sample, according to binomial tests.

Superscript letters indicate significantly *greater* attributions of knowledge to Ms. Smart compared to mom, according to Wilcoxon Signed Ranks Tests. Significantly fewer than 50% of 3- to 4.5-year-olds reported that Ms. Smart knew about all seven categories.

* $p < .05$, ** $p < .01$, *** $p < .001$

^a $p < .05$, ^b $p < .01$, ^c $p < .001$

Table 3-5

Study 3B: Reasoning Used to Justify Ms. Smart's Knowledge

Age group	Reasoning Category					
	Knows Everything	Intelligence	Ordinary Experience	Participant's Knowledge	Other	Uninformative
3 - 4.5 years	11%	19%	8%	17%	11%	34%
4.5 - 6.5 years	33%	36%	9%	4%	1%	17%
6.5 - 11 years	63%	19%	8%	3%	2%	6%
Adults	90%	6%	2%	0%	5%	1%

Note. Numbers reflect percentage of questions, per age group, for which participants used each of the six focal reasoning categories. Each participant was allowed to use multiple forms of reasoning for each of the five questions, thus some rows total more than 100%.

Table 3-6

Study 3B: Descriptive Statistics for Participants' Understanding of Infinity, Ability to Imagine the Improbable, and Exposure to Media about God

Age group	Understanding Infinity		Imagining the Improbable		Exposure to God Media	
	<i>M</i>	<i>(SD)</i>	<i>M</i>	<i>(SD)</i>	<i>M</i>	<i>(SD)</i>
3 - 4.5 years	.96	(.69)	2.71	(1.63)	2.25	(1.19)
4.5 - 6.5 years	1.18	(.61)	2.57	(1.69)	2.18	(.84)
6.5 - 11 years	1.68	(.98)	3.79	(.79)	2.50	(.95)
Adults	2.68	(.47)	4.00	(.00)	1.94	(.62)

Note. Scores for *understanding infinity* can range from 0 to 3. Scores for *imagining the improbable* can range from 0 to 4. The composite measure of participants' exposure to media about God can range from 1 to 5.

Table 3-7

Study 3B: Partial Correlations (Controlling for Age) Between Imagining the Improbable and Knowledge Attributed to Ms. Smart

Knowledge	Know Total	Past	Present	Future	Personal Events	Personal Actions	Personal Thought	Personal Prefs.	Within Expert Domain
3 - 4.5 years									
Seen Improbable	.37 †	.26	.37 †	.37	.27	.14	.25	.32	.14
Imagine Improbable	.06	.01	-.06	-.09	.03	.28	.12	-.05	-.05
4.5 - 6.5 years									
Seen Improbable	-.07	-.12	-.05	-.24	-.17	.14	-.03	.09	-.10
Imagine Improbable	.14	-.12	.05	.22	.15	.28	.09	.13	.01
6.5 - 11 years									
Seen Improbable	.23	.22	.08	.26	.19	.11	.26	.24	-.17
Imagine Improbable	.50 **	.24	.63 ***	.46 *	.47 *	.55 **	.38 *	.41 *	-.22
Adults									
Seen Improbable	.22	.19	.10	.22	.17	.22	.23	.21	-.02
Imagine Improbable	--	--	--	--	--	--	--	--	--

Note. “Know total” was computed by summing across all seven categories of knowledge in the breadth-of-knowledge task. All adults earned the maximum score (4) on the imagining-the-improbable task, and thus no correlations could be computed.

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 3-8

Study 3B: Partial Correlations (Controlling for Age) Between Religious Exposure and Knowledge Attributed to Ms. Smart

	Knowledge	Know Total	Past	Present	Future	Personal Events	Personal Actions	Personal Thought	Personal Prefs.	Within Expert Domain
3 - 4.5 years										
God Media		.16	.38	-.22	.31	-.02	.17	.12	.17	.07
Place of Worship		.12	.32	-.21	.27	-.04	.15	.11	.06	.05
4.5 - 6.5 years										
God Media		.43 †	.37	.43 †	.32	.43 †	.38	.27	.20	.08
Place of Worship		.55 *	.60 **	.54 *	.36	.56 *	.23	.44	.21	.19
6.5 - 11 years										
God Media		-.27	-.29	-.45 *	-.14	-.31	-.27	-.02	-.27	.16
Place of Worship		-.25	-.13	-.23	-.17	-.32	-.31	-.10	-.25	.27
Adults										
God Media		-.03	.11	-.11	-.04	-.20	.07	-.05	-.06	-.10
Place of Worship		-.08	.08	-.22	-.04	-.20	-.04	-.16	-.04	-.10

Note. "Know total" was computed by summing across all seven categories of knowledge in the breadth-of-knowledge task. 3-4.5 years, $n = 23$; 4.5-6.5 years, $n = 19$; 6.5-11 years, $n = 25$; adults, $n = 34$

† $p < .10$, * $p < .05$, ** $p < .01$

APPENDIX A

Studies 1 and 2: 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.



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.

APPENDIX B

Studies 3A and 3B: Expert Images (version for girls)



This is a mechanic. A mechanic is a person who fixes people's cars when there is something wrong, and makes sure cars run



This is a chef. A chef is a person who cooks food that people want to eat.



This is a pilot. A pilot is a person who flies planes, and helps people travel from one place to another.



This is a doctor. A doctor is a person who helps people when they are sick or hurt and makes sure that people are healthy.

APPENDIX C

Studies 3A and 3B: Questions Comparing Experts' and Ms. Smart's Knowledge

Pool of questions within experts' domains of knowledge, used for tasks in which experts are compared to one another, and in which experts are compared to Ms. Smart:

Doctor

- Who knows more about why you get a runny nose?
- Who knows more about what medicine you should take if you're sick?
- Who knows more about why you get a tummy ache?
- Who knows more about what food is healthy for you?
- Who knows more about being healthy? (only for Study 3B)

Mechanic

- Who knows more about why your car won't start?
- Who knows more about the best type of tires for your car?
- Who knows more about why some cars go very fast?
- Who knows more about what cars are made of?
- Who knows more about cars? (only for Study 3B)

Chef

- Who knows more about how much time it takes to cook eggs?
- Who knows more about which apples are sweet and which are sour?
- Who knows more about how different types of fruit taste?
- Who knows more about what ingredients go into different kinds of cakes?
- Who knows more about food? (only for Study 3B)

Pilot

- Who knows more about how wings on a plane work?
- Who knows more about how high different types of planes can go?
- Who knows more about which kinds of planes can flip?
- Who knows more about how fast a plane goes before it can lift off?
- Who knows more about planes? (only for Study 3B)

Pool of questions outside of experts' domains of knowledge, used for tasks in which experts are compared to Ms. Smart only:

- Who knows more about how trees grow?
- Who knows more about why some animals lay eggs?
- Who knows more about how a TV works?
- Who knows more about where germs come from?
- Who knows more about how rainbows are made?
- Who knows more about how phones work?
- Who knows more about why some people need glasses to see well?
- Who knows more about why giraffes have long necks?

APPENDIX D

Study 3A: Introduction to Ms. Smart (version for girls)

This is Ms. Smart. Ms. Smart has special powers. She knows *everything* about *everything* [spread arms].



[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. Ms. Smart *also* hasn't played with this before. But because she's so smart she still knows what's inside. We would have to look inside, but she doesn't even need to look. Let's ask Ms. Smart what's inside. Ms. Smart, what do you think is in here?

Ms. Smart says: "I know there's a stapler inside."

Let's see. [Open container and show child the stapler]. Ms. Smart was right!

Remember, Ms. Smart knows *everything* about *everything*, not just everything about boxes. Let me tell you about some other things Ms. Smart knows...

Do you know where this stapler was made?

Ms. Smart says: "I know it was made in Canada."

Let's take a look. [Look at bottom of stapler] Yep, it says "Canada."

Do you know how many staplers are made in Canada each year? Me neither. But Ms. Smart does, because remember she knows *everything* about *everything* [spread arms]—about boxes, about staplers, about Canada, *everything*.

APPENDIX E

Study 3B: Introduction to Ms. Smart (version for girls)

This is Ms. Smart. Ms. Smart was born with a *very, very* special brain. She knows *everything* about *everything* [spread arms].



[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. Ms. Smart *also* hasn't played with this before. But because she's so smart she still knows what's inside. We would have to look inside, but she doesn't even need to look.

Let's ask Ms. Smart what's inside. Ms. Smart, what do you think is in here?

Ms. Smart says: "I know there's a stapler inside."

Let's see. [Open container and show child the stapler]. Ms. Smart was right!

Remember, Ms. Smart knows *everything* about *everything*, not just everything about boxes. Let me tell you about some other things Ms. Smart knows...

Do you know where this stapler was made?

Ms. Smart says: "I know it was made in Canada."

Let's take a look. [Look at bottom of stapler] Yep, it says "Canada."

Do you know how many staplers are made in Canada each year? Me neither. But Ms. Smart does, because remember she knows *everything* about *everything* [spread arms]—about boxes, about staplers, about Canada, *everything*.

APPENDIX F

Study 3B: Questions about Ms. Smart's and Mom's Knowledge

Does [Ms. Smart/your mom] know what the very first dog looked like long ago?

Does [Ms. Smart/your mom] know where to find the tallest tree in the world?

Does [Ms. Smart/your mom] know when your dad's birthday is?

Does [Ms. Smart/your mom] know what your favorite food is?

Does [Ms. Smart/your mom] know what your dad is thinking right now?

Does [Ms. Smart/your mom] know how hot the weather will be next summer?

If your friend did something naughty at school, and nobody saw, would [Ms. Smart/your mom] know your friend did it?

Does [Ms. Smart/your mom] know how many people will live on Earth next year?

Does [Ms. Smart/your mom] know what you're thinking right now?

Does [Ms. Smart/your mom] know what the very first plane sounded like long ago?

If you did something naughty at school, and nobody saw, would [Ms. Smart/your mom] know you did it?

Does [Ms. Smart/your mom] know where to find the longest river in the world?

Does [Ms. Smart/your mom] know when your birthday is?

Does [Ms. Smart/your mom] know what your dad's favorite food is?

APPENDIX G

Study 3B: Imagining-the-Improbable Task Questions

Have you ever *seen* a person who has a lion for a pet?

Could a person have a lion for a pet in *real life*?

Can you close your eyes and *think* about a person with a pet lion?

Have you ever *seen* someone drink onion juice?

Could a person drink onion juice in *real life*?

Can you close your eyes and *think* about someone drinking onion juice?

Have you ever *seen* someone paint polka dots on an airplane?

Could a person paint polka dots on an airplane in *real life*?

Can you close your eyes & *think* about someone painting polka dots on an airplane?

Have you ever *seen* someone make purple applesauce?

Could a person make purple applesauce in *real life*?

Can you close your eyes and think about someone making purple applesauce?

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