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Correspondence Between Parents' and Children's Scientific and Religious Concepts

A Dissertation submitted in partial satisfaction  
of the requirements for the degree of

Doctor of Philosophy

in

Psychology

by

Anondah Rose Saide

September 2018

Dissertation Committee:

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The Dissertation of Anondah Rose Saide is approved:

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Committee Chairperson

University of California, Riverside

## DEDICATION

I dedicate this dissertation to my father, Philip Jay Saide.

To put it lightly, this has been an arduous life, and I could not have made it without your love, encouragement, support, and faith in science. Thank you, Dad.

I would also like to acknowledge the following people: Kevin McCaffree, Pigmond, Monkey, Shayna and Shia Labeouf, Lizzy and the Porter Family, Elizabeth Saide, Parisa Parsafar, Patricia and Stephen McCaffree, Alexandra Maryanski, Michael Shermer, Scott L. Thomas, Molly Schlesinger, Nicholas Shaman, Ashley Ricker, Courtney Baugh, Tatiana Garcia, Susie and Steve Abrams, my research assistants (Jessica, Rachel, Liana, Marisa, Brianna, Kenghuy, Christine, Katharine, and Catherine), all the families that participated in this study, Rebekah Richert, Mary Gauvain, Liz Davis, and in memory of, Barry Saide.

## ABSTRACT OF THE DISSERTATION

Correspondence Between Parents' and Children's Scientific and Religious Concepts

by

Anondah Rose Saide

Doctor of Philosophy, Graduate Program in Psychology  
University of California, Riverside, September 2018  
Dr. Rebekah Richert, Chairperson

The enculturation of abstract concepts involves the interaction between attributes of the child (e.g., age, reasoning heuristics) with factors that are extrinsic, such as the cultural context. The present study examined the degree to which parents and children correspond in their concepts of a religious entity (i.e., God) and a scientific entity (i.e., germs). The influence of parent context on correspondence of concepts of God and germs was also examined by measuring the predictive power of (a) characteristics intrinsic to the parent (e.g., parent's beliefs and values) and (b) the social learning situations created by parents (e.g., engagement of children in behaviors and discourse related to the entities). Participants included 123 parent-child dyads diverse in ethnic and religious background. Children were between 5-and-8.9 years of age. The following central findings emerged: First, parents and children separately conceptualized the psychological and physiological properties of God and germs in ways consistent with prior research. Second, correspondence between parents and children was lowest for God's physiological properties (i.e., children thought God had physiological properties and parents did not) and highest for germs' psychological properties (i.e., both parents

and children conceptualized germs as lacking psychological properties). Third, parent context factors were most influential for correspondence of God's psychological properties. These results suggest that children's intuitive reasoning about agents during the early-to-middle childhood period of development may impact the influence of parents on abstract concept development; and that parent contexts are more influential for the correspondence of religious, as opposed to scientific concepts.

## Table of Contents

Chapter 1: Introduction .....	1
Chapter 2: Current Study .....	44
Research Objectives & Hypotheses .....	44
Methods .....	48
Chapter 3: Results.....	64
Research Objective 1 .....	64
Summary .....	74
Research Objective 2 .....	76
Summary .....	84
Research Objective 3 .....	87
Summary .....	108
Chapter 4: Discussion .....	112
References .....	152
Appendix A .....	166
Appendix B .....	172
Appendix C .....	178



## List of Tables

Table 1:	Entity Concept Scores .....	53
Table 2:	Theory-of-Mind Tasks: Pass Statistics .....	60
Table 3:	Parents' Concept of God .....	65
Table 4:	Children's Concept of God .....	67
Table 5:	Parents' Concept of Germs .....	70
Table 6:	Children's Concept of Germs .....	71
Table 7:	Item-by-item Parent-Child Correspondence: God Concepts .....	79
Table 8:	Item-by-item Parent-Child Correspondence: Germ Concepts .....	83
Table 9:	Concepts of God Correspondence: Correlations, Means, and SDs .....	178
Table 10:	Moderation Analyses for God Correspondence: Mind-Dependent .....	92
Table 11:	Moderation Analyses for God Correspondence: Body-Dependent .....	93
Table 12:	Initial Source Reported by Child for God .....	97
Table 13:	Source of Discourse About God: Reported by Child .....	98
Table 14:	Concepts of Germs Correspondence: Correlations, Means, and SDs ....	179
Table 15:	Moderation Analyses for Germs Correspondence: Mind-Dependent ....	101
Table 16:	Moderation Analyses for Germs Correspondence: Body-Dependent ....	102
Table 17:	Initial Source Reported by Child for Germs .....	105
Table 18:	Source of Discourse About Germs: Reported by Child .....	106
Table 19:	Child Attributes and Parent-Child Concept Difference Scores .....	108

## **List of Figures**

Figure 1:	Conceptual Model Examined in Research Objective Three .....	48
Figure 2:	Confirmatory Factor Analysis: Salience .....	91
Figure 3:	Predicting Correspondence of God’s Mind-Dependent Properties .....	95
Figure 4:	Predicting Correspondence of God’s Body-Dependent Properties .....	96
Figure 5:	Predicting Correspondence of Germs’ Mind-Dependent Properties .....	103
Figure 6:	Predicting Correspondence of Germs’ Body-Dependent Properties .....	104

## **Chapter 1: Introduction**

Concepts develop through the interaction between traits related to the individual (i.e., endogenous factors) and aspects of the individual's cultural context (i.e. exogenous factors) (Gauvain & Perez, 2015; Vygotsky, 1978). Examples of endogenous factors relevant to children's development of concepts include theory of mind, executive functioning, and analytical reasoning abilities (Lane & Harris, 2014). Exogenous factors include but are not limited to parents' purported beliefs about a topic and the behaviors that accompany those beliefs (Lane & Harris, 2014). Exogenous and endogenous factors work together in enculturation processes; in other words, processes that facilitate children's formation of concepts that are commonly held by others in their social environment.

God and germs are two abstract concepts that hold great importance to adults and to societies, and are learned about by children through enculturation processes. God and germs both relate to panhuman concerns (e.g., the meaning of life; health) and derive from ordinary panhuman cognitive processes (e.g., agency detection) (Atran & Norenzayan, 2004; Barrett, 2012; Brown, 1991; McCauley, 2011). God is often cited as important for dealing with individual existential concerns (Kay, Whitson, Gaucher, & Galinsky, 2009), and germs are treated as a public health concern (e.g., Center for Disease Control). Both God and germs require abstract reasoning because they cannot be directly experienced via our perceptual observations (e.g., sight, touch). Instead, God and germs must be learned about through other people and social learning processes.

God is an invisible agent without a material referent in the natural world. A germ is an agent with a material referent in the natural world but cultural tools (e.g., a microscope) are required in order to make that referent apparent.

Even though scholars argue that both religious and scientific concepts coexist in individual minds (e.g., Legare, Evans, Rosengren, & Harris, 2012), institutional emphasis on them has shifted, thereby changing the contexts in which children learn about them. For example, in the 1960s the Supreme Court declared it unconstitutional for public schools to incorporate prayer and bible reading (e.g., *Engel v. Vitale*, 370 U.S. 421 [1962]); while God was once a common feature of most children's learning environments (i.e., in home, church, and school), this is no longer the case due to changes in the law and the economy. Businesses strive to appeal to the largest possible audience, which means most try to appear religiously impartial. Scientific concepts like germs on the other hand, are apolitical and are freely and frequently mentioned in public spaces such as school and medical contexts (e.g., California Department of Education, 2009). Concepts of God and germs have many differences, but their similarly abstract nature, and development via social learning make them useful targets for a study on the social context factors that predict correspondence between children and adults' concepts. Inclusion of both a religious and scientific concept is important because it is likely the case that they are not learned about from family (e.g., parents) to the same extent. Religious concepts may be primarily learned about through family contexts; while scientific concepts are learned about in a greater number of contexts. This study sought to examine whether and how parent context factors (i.e., characteristics intrinsic to the

parent and the social learning opportunities created by the parent) mattered in parent-child correspondence for both a religious and scientific concept.

The current study examined the moderators and mediators of parent-child correspondence of abstract concepts. Specifically, this study had four goals. The first goal was to describe the content of both children's and parent's concepts of God and germs. The second goal was to measure the extent to which children's concepts were related to one of their parent's concepts. The third goal was to examine factors (e.g., parent context and child attributes) that may facilitate correspondence between parents' and children's concepts of God and germs. The fourth goal was to explore whether or not the same mediators and moderators were related to the correspondence of a religious-supernatural (i.e., God) concept and a natural-scientific (i.e., germs) concept.

This research is distinctive in three ways. First, it incorporates findings from across the social sciences including sociology, human development, and developmental psychology (e.g., Bader & Desmond, 2006; Bengtson, Putney, & Harris, 2013; Harris & Koenig, 2006). Second, it incorporates factors that are not usually studied together in concept development, factors such as socialization practices, theory-of-mind, and the perceived importance of the concept by parents. Even though parental influence (e.g., beliefs, behaviors) is often incorporated as predictors of children's abstract concepts, delineating predictors of the actual *correspondence* in conceptual content between parent-and-child is understudied. For example, a study might use a parent's religious affiliation to predict their child's concept of God, but that same study will not examine predictors of the difference in concepts of God between parent-and-child (e.g., Richert, Saide, Lesage,

& Shaman, 2017). Lastly, the predictors of correspondence examined in this study use two abstract concepts from two highly salient, but different domains of life, science and religion. This is done with a religiously diverse sample of parent-child dyads.

The current study tested a conceptual model predicting concept correspondence among children ages 5-to-8.9-years and one of their parents. The conceptual model predicting correspondence included (a) context factors specific to the parent (e.g., parent's beliefs and values) (b) social learning opportunities created by parents (e.g., engagement of children in behaviors and discourse related to the entities), (c) children's beliefs about the reality status of entities, (d) parent-reported importance of the entity concept for their child, and (e) intrinsic attributes of the child (theory-of-mind ability, age, and executive functioning). The factors listed above were chosen because previous research has suggest that they might be important to concept development (e.g., Gauvain & Perez, 2015; Hoge, Petrillo, & Smith, 1982; Richert, Saide, Lesage, & Shaman, 2017; Shtulman, 2018). For the purpose of the current study, correspondence was operationalized as similarity between parents' and children's concepts.

## **Concepts**

Scholars that study the formation of concepts, study concepts from a range of perspectives and academic fields; as a result, there are several ways to define *concept*. A conventional definition has been to think of concepts as mental representations, likely associated with a cognitive architecture, that organize our experiences and are sometimes thought of as equivalent to a single word (e.g., heart, weight, object) (Carey, 2000; Gelman, 2009). Though general, this definition highlights the fact that individual

concepts also can be joined to create complex representational structures, such as propositions (e.g., “Santa Claus prefers to eat cookies while he delivers presents”, “The Bible is the literal word of God”) (Carey, 2000). Beliefs and concepts are distinct in that an individual may mentally represent (i.e., have a concept of) a phenomenon but may not believe that conception is true. For example, most adults have concepts of Santa Claus but do not believe Santa Claus exists in *real* life. Although an individual may not need to believe a concept to be true to conceptualize it, an individual must first conceptualize something in order to believe it to be true. In other words, concepts are necessary, but not sufficient for belief.

However, belief in a phenomenon likely impacts an individual’s motivation to disseminate the concept to other people. For example, high school science teachers who do not believe that humans have contributed to global climate change may not spend time teaching climate change to their students and/or will be dismissive of pollution caused by humans as a possible factor in climate change when they do discuss it in their lectures.

Implicit concepts (and implicit attitudes) constitute representations that differ from explicit ones, at least in terms of awareness, effort, and efficiency (Heiphetz, Lane, Waytz, & Young, 2016; Nosek, 2007). Implicit concepts exist without deliberation or introspection. They are expressed quickly with minimal effort and may not be articulated or verbalized because of the lack of awareness of them by the individual. Explicit concepts take deliberate intentional thought, are expressed slower relative to implicit concepts, and can be articulated by the individual because they exist at conscious awareness. Implicit and explicit concepts may significantly differ from each other, but

they also may be related; in other words, the degree to which implicit and explicit concepts differ varies along a host of factors that include but are not limited to personal experience and individual difference characteristics like age and executive functioning (Nosek, 2007; Shtulman & Harrington, 2015). For example, adults are less likely than children to hold explicit humanlike concepts of non-human entities but may hold implicit humanlike concepts of those entities. On the other hand, children may hold both implicit and explicit humanlike concepts of non-human entities (Heiphetz, Lane, Waytz, & Young, 2016).

Concepts are based in part on individual experience; and as result, concepts will change across an individual's life course (e.g., concept of "mom" at age 5 years versus concept of mom at age 15 years versus when that individual becomes a "mom"). Kagan (2008) argued that while babies have concepts, they have not developed semantic knowledge, which impacts how sophisticated those concepts are. Concepts that a preverbal infant possesses, for example, are likely more rudimentary (i.e., more general) than the concept that the infant's mom possesses. Another example of this principle comes from a study by Shtulman and Carey (2007). They found that while younger children (between 4-7 years of age) stated that improbable events (i.e., events that are possible but unlikely; e.g., someone drinking onion juice) and impossible events could not happen in real life (i.e., concept of possibility), older children and adults were more likely to distinguish between improbable and impossible events. In other words, the meaning of what is and what is not possible, changes in part as a function of one's experience with the world.



**Conceptual categories.** There are different ways to categorize concepts. Medin, Lynch, and Solomon (2000) provided three criteria for distinguishing between concept types: (a) structural differences or distinguishing between the features of concepts (e.g., light versus heavy), (b) processing differences or distinguishing based on types of processing done to develop and maintain concepts (e.g., observational versus testimonial), and (c) content-laden principles or distinguishing between concept domains (e.g., biological versus physics). The second approach to distinguishing concept types is the one taken here, and consistent with that of the developmental theorist, Lev Vygotsky.

Lev Vygotsky reasoned that the driving force of cognitive development was external (i.e., social world and social interaction) to the child (Howe, 1996; Piaget & Inhelder, 1969). For example, Vygotsky (1978) reasoned that children form concepts through everyday experiences and instruction (Howe, 1996; Vygotsky, 1978). The everyday concepts Vygotsky referenced are sometimes labeled as intuitive or spontaneous concepts, whereas those that are forged with the aid of instruction or cultural input are labeled as scientific or nonspontaneous. The latter set will not be referred to as “scientific” because not all nonspontaneous concepts are scientific in nature; in the current study, the term “nonspontaneous” is used to refer to those concepts Vygotsky considered “scientific.” All nonspontaneous concepts are cultural concepts, and there is variation in the degree to which nonspontaneous concepts require cultural input and instruction to form. But the concepts studied in the current research are referred to as “nonspontaneous” and/or “abstract” because they require a non-trivial degree of information (i.e., via testimony, instruction) from other people to develop.

Vygotsky argued that spontaneous (i.e., intuitive) and nonspontaneous concepts have a dialectic relationship in which change is an ongoing process. Children integrate spontaneous concepts into, “a system of related concepts and transform the raw material of experience into a coherent system of concepts” (Howe, 1996, p. 39). Children use metacognitive (e.g., reflection) processes to transform and generalize knowledge to organize concepts into hierarchical systems of interrelationships. An example of a relatively spontaneous concept that humans develop through personal experience with the world around them via their biologically endowed senses (e.g., sight, touch), that can be influenced by culture, but may not require cultural input to develop, is the concept of distance (i.e., there is space between objects) (Carey, 2009). Nonspontaneous concepts, on the other hand, are conceived of as not forming without the help of cultural tools. Cultural tools can include inanimate objects such as microscopes, contact lens, hearing aids, and computers. They can also include animate objects such as people who can communicate by way of speech, written word, and/or in other symbolic ways such as photographs, drawings, and/or engaging in rituals (e.g., cooking, praying).

Concepts of central interest for the current study are nonspontaneous concepts, which include scientific concepts (e.g., species), socially constructed concepts (e.g., race), abstract concepts (e.g., free will), and supernatural concepts (e.g., ghosts) (Gelman, 2009). The research here is particularly focused on concepts that remain mostly abstract during early childhood (e.g., religious, and some scientific such as germs). Some nonspontaneous concepts (e.g., free will, evolutionary timescale) always remain abstract even with the assistance of cultural tools because they never have a material referent in

the physical world to which the child can anchor her or his understanding (Hampton, 2015). On the other hand, some concepts (e.g., germs, shape of the earth) become more concrete, at least in principle, over the course of development, because cultural tools allow the child to observe the phenomena through her or his sensory systems (Harris, Pasquini, Duke, Asscher, & Pons, 2006). For example, concrete or everyday spontaneous concepts, for Vygotsky, reference phenomena existing in a material or physical form, so if a child is given a telescope to see what is in outer space, a once abstract concept such as the planet Mars, can become concrete. What follows is a more in-depth discussion on the two nonspontaneous concepts—God and germs—that were drawn on in this study to examine the moderators and mediators of parent-child conceptual correspondence.

### **Supernatural Concepts**

Supernatural concepts represent phenomena that violate, operate outside of, and/or are viewed as distinct from the natural world and laws that govern the natural world (Chinn & Brewer, 2000). Such concepts are generally not empirically falsifiable and range from simple (i.e., single concepts; e.g., ghost) to complex (i.e., comprising multiple embedded concepts; e.g., God is omniscient). Some supernatural religious concepts are related to immaterial agents (e.g., deities, angels, ghosts), events (e.g., virgin birth, genesis flood), and places (e.g., heaven, hell, purgatory). The current study examines concepts related to one supernatural agent in particular, God.

**Concepts of God.** Researchers have examined the content and development of the concept of God over the last two decades. The existing research has been conducted predominately with individuals that either identify as a member of a monotheistic

religion, or live in a society in which the majority of people around them are members of a monotheistic religion. Scholars in the cognitive science of religion argue that concepts of supernatural beings like God are rooted in intuitive knowledge domains with features that are counterintuitive. For example, Boyer (2003) has argued that a supernatural being, such as God, is conceptualized as one's intuitive conception of "person" (or agent) implicitly; but is then modified to include person with *special properties* counterintuitive to one's concept of "person." In other words, God may be conceptualized as humanlike implicitly but as special and different (e.g., having a mind and no body, as having special powers), explicitly.

Research on children's concepts of God has taken several approaches. One approach is to explore children's understanding of whether or not God has knowledge using traditional theory-of-mind tasks. Such research has revealed that older preschool-aged children are more likely to attribute false-beliefs (i.e., fallible knowledge) to their mom than to God (i.e., infallible knowledge) (Barrett, Richert, & Dreisenga, 2001). Lane, Wellman, and Evans (2012) found that secularly-schooled children (drawing additional data from the Lane, Wellman, and Evans, 2010 study) were somewhat more likely than religiously-schooled (Protestant Christian) children to attribute fallible knowledge to God.

Cross-cultural work in this area by Knight, Sousa, Barrett, and Atran (2004) with Mayan children using a surprising contents false-belief task, yielded a similar developmental pattern found in previous work with Christian children in the United States—as age increased, children were more likely to attribute false-beliefs to their

mom, but not to God (Barrett, Richert, & Dreisenga, 2001; Barrett, Newman, & Richert, 2003). A study done with children (3-to-8-years-old) from Greek Orthodox backgrounds utilizing an ignorance-knowledge task found dissimilar patterns from the earlier work discussed, younger children in the sample were unable to discriminate between Titi (the human agent in the study) and God's mind (Makris & Pnevmatikos, 2007). In other words, they treated both as having fallible knowledge. In a recent, religiously-diverse study that explored the degree to which children differentiate the minds of humans and God, children of Muslim parents treated God and humans more dissimilarly than did their Catholic, Protestant Christian and religiously non-affiliated counterparts (Richert, Saide, Lesage, & Shaman, 2017). In addition, the children of Muslim parents were the least likely to attribute fallible knowledge to God while simultaneously attributing fallible knowledge to human agents.

Some researchers have examined how children conceptualize God in terms of general psychological, biological and physiological traits. For example, Shtulman (2008) conducted a study with 5-year-old children that investigated whether or not children reasoned that psychological (e.g., thinks, dreams), biological (e.g., eats, grows), and physical (e.g., sits, jumps) properties could be attributed to God. Shtulman (2008) found that children were more likely than their parents to state that those properties could be attributed to God; in other words, children were more humanlike in their conceptions of God. Another study by Richert and Barrett (2005) inquired about children's (preschool to early childhood; aged 3 to 7 years) understanding of God's perceptual access (i.e. visual, auditory, and olfactory sensory perceptions). Older children in the sample reported that

God had extraordinary perceptual capacities as compared with human agents. Overall, children as young as 4-years-old are able to communicate conceptions and beliefs about God regarding a wide range of aspects/domains.

With adults, Shtulman and Lindeman (2015) found that adults implicitly conceptualize God as having mind-dependent properties (i.e., mental; e.g., to think, to feel emotions), but only body-dependent properties (i.e., physiological; e.g., that drinks, dies, grows old) with further consideration. More specifically, Shtulman and Lindeman (2015) found that adults anthropomorphized God's psychological attributes more quickly, consistently, and confidently than God's physiological attributes. God was granted physiological properties only explicitly after participants were given time to reflect about it. In the same study, the granting of God these humanlike properties was positively related to the participant's religiosity for 46 of the 48 properties asked about. Overall, concepts of God as a supernatural agent have been explored in a number of ways and research suggests that explicit conceptions of God as being humanlike vary across age and religious background (Shtulman, 2018).

### **Scientific Concepts**

Natural (i.e., scientific) concepts represent, in principle, observable and empirically-verifiable phenomena of the material (i.e., physical) world (Chinn & Brewer, 2000). Goode (2000) further suggested that phenomena placed under a "scientific" (beyond just "natural") category are distinguishable from supernatural and religious concepts in that scientists as a whole have come to generally agree (i.e., have come to consensus) that scientific phenomena actually exist in the world. Therefore, which

phenomena are considered natural or supernatural changes over time as scientists learn more about the natural world through increasingly sophisticated and precise tools for experimentation and deduction. Vygotsky (1978) called concepts that are formed with the assistance of instruction, scientific concepts; however, not all cultural concepts are “scientific” in Goode’s (2000) sense. Further, under Vygotsky’s (1978) definition, religious and scientific concepts can be confused because they both would be labeled “scientific.” As a result, for the current study, concepts that require instruction are referred to as, “nonspontaneous” subsets of nonspontaneous concepts are labeled as “supernatural-religious” or “natural-scientific” when appropriate.

On average, emerging adults endorse the existence of scientific phenomena (e.g., electrons, evolution, genes) more than supernatural phenomena (e.g., heaven, souls, fate) (Shtulman, 2012). Emerging adults also tend to be more *confident* in the existence of scientific phenomena, perceive greater consensus concerning how many other people believed in the existence of scientific phenomena, and are more open to revision for scientific beliefs. In a study by Shtulman (2012), emerging adults cited more subjective evidence (e.g., appeals to one’s intuition) for religious beliefs.

Chinn and Brewer (2000) have also noted that when it comes to conceptual change among children, adults, and experts, scientific phenomena are subject to peripheral theory change (i.e., making of minor changes to a theory to accommodate new data) and adoption of new theories when faced with new data. However, religious phenomena constitute a closed system of knowledge, and are not changed or revised in the same way when contradictory data are presented (Chinn & Brewer, 2000); rather,

children and adults ignore the new data, reject it as invalid, claim it is not relevant, or reinterpret it to fit existing conceptual content. The current study examines concepts of germs, which constitute a natural-scientific agent.

**Concept of germs.** Germs are scientific entities that are mentioned in everyday conversations in ways related to behaviors (i.e., washing hands, covering nose when sneezing) meant to avoid exposure to and the spread of germs (Shtulman, 2017). Germs are microorganisms too small to see with the naked eye, that can spread and cause illness. Germs include any microorganism that can cause disease including but not limited to: bacteria, viruses, fungi, and protozoa. Germs engage in directed action (e.g., search for nutrients), exert preferences (e.g., for environments), and coordinate with other germs (e.g., via sending electrical signals) therefore, germs are a kind of biological agent, but importantly, not a conscious agent (e.g., Persat et al., 2015). Any organism that acts in ways to survive and adapt, are agents (Dennett, 1996).

Children claim with confidence that scientific entities such as germs exist but also indicate they do not know what germs look like (Harris, et al., 2006). Children understand the notion of contagion, as in rotting food has germs that make you sick. They also report that germs are too small to be seen, and can be passed around or spread. However, children do not essentially understand the notion of a germ itself; they do not accurately (i.e., consistently) conceptualize germs as living organisms (Ergazaki, Saltapida, & Zogza, 2010; Shtulman, 2017).

By age 4 and 5 years, children understand that germs play a role in contagion and contamination and that in some situations germs are the underlying cause of illness



(Kalish, 1996). During early childhood, children understand that the presence or absence of germs is related to illness, but have a limited understanding of how and why germs cause illness (Kalish, 1999). Children also underestimate the role of germs in illness (i.e., underestimate the number of illnesses germs cause). Preschool-aged children mainly associate germs with health and hygiene. In one study, over 80% of children associated germs with health. When those same children were asked to reason about the biological functions of germs, they either did not explicitly provide reasoning about why germs do or do not have biological properties, or (and significantly less often) they reasoned by comparing germs to humans (Ergazaki, Saltapida, & Zogza, 2010).

Researchers have also examined how children conceptualize germs in terms of psychological, biological and physiological traits. In a study on the attribution of biological (e.g., to move, to eat, reproduce, grow old) and psychological (e.g., to think, to feel emotions) properties to germs, children generally did not grant germs properties customary of living entities (Solomon & Cassimatis, 1999). The study included children from preschool to middle childhood, and adults. Less than 8% of children granted germs psychological properties, and less than half granted germs biological properties. The majority (94%) of adults conceptualized germs as animate entities with biological properties.

### **Reasoning About God and Germs**

An important caveat is merited: the type of reasoning described above about whether or not God or germs possess psychological (mind-dependent) and physiological (body-dependent) properties is often referred to as *anthropomorphic* reasoning (e.g.,

Shtulman, 2008). However, the traits often asked about are not necessarily unique to humans; rather, they are customary of traits you see across the animal kingdom and reasoning about them partially derives from children's general folk theorizing about the relations between objects (i.e., folk physics), the mental states of agents (i.e., objects that can engage in self-propelled goal-directed motion; folk psychology), and the nature of living things (i.e., folk biology).

**Folk theories.** Scholars argue that children are biologically prepared, through evolutionary selection pressures, to rapidly develop three knowledge systems or theories about phenomena that concern: (a) mental states and social stimuli, referred to as folk psychology; (b) biology and ecological stimuli, referred to as folk biology, and (c) object relations, referred to as folk physics (Wellman & Gelman, 1992). Though it is argued that children are biologically prepared to learn about these ontological domains and tend to do so before school age (Wellman & Gelman, 1992; Rakison & Poulin-Dubois, 2001), the social context still plays an important role in shaping children's and adults' understandings. Children's cognitive development is fundamentally intertwined with the social context in which children are raised. The social context shapes *how* children learn and conveys to children *what* is important to learn (Gauvain & Perez, 2015).

Folk psychology refers to how we understand the mental or psychological aspects of our social environment (Wellman & Gelman, 1992). It includes, but is not limited to, understanding that mental life (e.g., thoughts, desires) is immaterial and subjective. Folk physics refers to how we understand aspects of the physical world in which we live (Wellman & Gelman, 1992). It includes, but is not limited to understanding distinctions

between animate and inanimate objects, object solidity, and the causal dynamics between objects (e.g., ball moves because another object collided with it). Folk biology refers to how we understand the biological world in which we live (Wellman & Gelman, 1992). It includes but is not limited to understanding biological kinds (e.g., animals, humans), and the characteristics of living versus non-living things. Children's understanding within and between these domains develop at different rates; for example, while children between 4- and- 5 years of age typically pass false-belief tasks (i.e., one indicator of an accurate understanding of mental states), children may demonstrate a poor understanding of biological kinds until 7- to- 10- years of age (Carey, 1985). Importantly, the social context impacts children's understanding of these domains. For example, children who have experience with animals, tend to have a more advanced understanding of biological kinds and the biological processes of nonhuman animals; and children with older siblings may pass theory-of-mind tasks earlier (Atran, et al., 2001; Chen, 2012; Geerdts, Van de Walle, & LoBue, 2015).

Debate exists about whether or not folk biology constitutes a distinct knowledge domain from folk psychology among children, as it does for adults. Carey (1985) has argued that folk biology does not become a distinct domain until well into middle childhood, when she argues that children undergo radical conceptual changes in anthropocentric reasoning. The argument there is that children use what they know of human psychology (and human biological functions) to inform their answers about nonhuman or novel entities.

Inagaki and Hatano (2006) argued that young children have a theory-like knowledge system related to biology as indicated by their ability to distinguish between living/non-living, the mind/body, and to make causal predictions for biological phenomena. Young children distinguish living from non-living using their understanding of animate versus inanimate object. Young children are likely to identify something as living if it can move on its own, but the mistake that young children make is that, “not all animate entities are alive and not all living entities are animate, at least not to the naked eye” (Shtulman, 2017, pp. 138-139).

Children are able to reason about the likely causes, including biological causes, of outcomes (Schult & Wellman, 1997). Children have been shown to appropriately attribute whether an action was caused by something psychological, physical or biological. For example, in a study by Schult and Wellman (1997) children were told a series of stories in which a protagonist desired an action and the action either happened or was prevented from happening. Children then were asked for explanations for why the outcomes occurred. In stories in which the cause was biological (e.g., a biological limitation like getting tired), children more often than not, correctly gave a biological explanation. The same was the case for outcomes caused by something psychological or physical; children more often than not correctly gave an explanation that matched.

In addition to the studies described above pertaining to God and germs, other studies have found that children can make a distinction between the mind and body, mental and physiological. One way the question of domain distinctions has been examined is by asking children whether a series of types of animals possess biological

(body-dependent) and psychological (mind-dependent) properties. Researchers examine whether or not children grant different species applicable properties (e.g., all animals reproduce but not all have bones, only vertebrates do). An early study by Coley (1995) demonstrated that as early as kindergarten, children can distinguish the psychological and biological properties of nonhuman living things. In Coley's (1995) study, kindergarten children attributed biological properties (e.g., has blood, has bones, sleeps) to predatory and domestic animals equivalently but distinguished which psychological properties (e.g., smart, angry, happy, scared) they might have. Children distinguished between the domains of psychology and biology, but did not do so along taxonomic lines (e.g., mammal versus reptile) suggesting that kindergartens still do not possess an accurate folk biology.

Overall, children have an understanding of biology as separate from psychology and physics but the reasoning young children use is still considerably human-centric; especially if those children have limited experience in nature, and/or have limited experience with animals. For example, Medin, Waxman, Woodring, and Washinawatok (2010) conducted a study with children (ages 4 to 10 years) from rural European American, urban, and Native American communities. Children were taught that a dog or human has a novel property and then on another day were asked if 16 target items (e.g., human, dog, aardvark, bee, dandelion, sun, pencil) have that same property. Overall, by age 6-years children in all three populations showed a bias to use a dog (over the human) as an inductive base to reason about the other entities; but rural European American

children demonstrated this inductive bias with a dog as early as 4 to 6 years of age—suggesting that experience alters the children’s usage of human-centric reasoning.

These folk theories can constrain and/or enhance children’s learning depending in part on what children are trying to learn (e.g., evolution) and when in the course of development instruction takes place (Shtulman, 2017). As has been discussed, children mistakenly attribute life to things that appear to move on their own, yet are non-living (e.g., sun, wind), while denying life to living things that appear to the child to be inanimate (e.g., flowers and trees). But under timed conditions and/or with cognitive decline, adults increasingly make the same type of mistakes—they revert to older intuitive theories about how the world works which may be true or false (Lombrozo, Keleman, & Zaitchik, 2007; Shtulman & Harrington, 2015).

What is central about these domains for children and adults is in distinguishing between them. As Wellman and Gelman (1992) stated, there are three empirically supported assumptions about the core domains of folk psychology, biology and physics, “(a) children honor core ontological distinctions; (b) children use specific causal principles in reasoning about particular domains; and (c) children's causal beliefs cohere and form a larger interconnected framework” (p. 366). An *ontological confusion* is when these domains are applied in ways that are not accurate (Lindeman, Svedholm-Hakkinen, & Lipsanen, 2015). For example, the sun is a physical object, it is not living and does not have mental states; therefore, a confusion would be if someone conceptualized the sun as having psychological properties in part, by agreeing with the statement, “The sun looks happy today.” Supernatural, some religious, and some scientific concepts inherently do

not adhere to the distinctions between the three domains discussed above; as a result, in order to believe in such conceptualizations, the individual blurs distinct ontological categories (Lindeman, Svedholm-Hakkinen, & Lipsanen, 2015).

### **How God and Germs Differ**

Although God and germs are both nonspontaneous abstract concepts that remain important to a significant portion of people throughout the life course, they also differ in meaningful ways. Meaningful, because the ways in which they differ likely impact how children learn about God and germs, and how children reason about God and germs. As result, a review of the ways in which they differ is warranted. God and germs differ in: (a) ontological status, (b) sources of cultural information, (c) motivations for behavioral engagement, (d) emotionality and the collective nature of behaviors, (e) conception of consciousness, and (f) social identity.

***Ontological status.*** In a series of experiments, Harris and colleagues (2006) explored children's perceptions of the ontological status of (a) *real* entities (e.g., wolves, tigers), (b) *scientific* entities (e.g., germs, oxygen), (c) *endorsed* entities (e.g., Tooth Fairy, God), (d) *equivocal* entities (e.g., ghosts, monsters), and (e) *impossible* entities (e.g., flying pigs, red elephants). Children were between the ages of 4 years and 8 years-of-age. Harris and colleagues (2006) found that across all ages, children were more accurate about the ontological status of real, scientific, and impossible entities. In other words, children were more likely to state that these entities were real. Even though children expressed certainty in the existence of endorsed entities (i.e., God) and scientific (i.e., germs) entities, children expressed greater certainty in the existence of scientific

entities, and were more likely to insist that other people believe in their existence (Harris et al., 2006).

Harris and Koenig (2006) posited at least three possibilities for why children would express greater confidence in the existence of scientific entities like germs, over entities like God, that are still endorsed in testimony with children. First, children eventually come to understand that germs can be observed with special instruments like a microscope; while God remains unobservable—possibly reducing children’s beliefs about God’s reality. Second, children may observe that the causal narrative surrounding germs remains consistent with their experience and their understanding of natural laws. For example, if a child does not engage in hygienic behaviors, she or he is more likely to become ill. However, the causal narrative for supernatural or fantastical beings may seem less plausible or at least more questionable as children better understand causal constraints. For example, as children become more accurate about what is and what is not physically possible, they become more skeptical about the possibility of the extraordinary things that Santa Claus is reported to do (Shtulman & Yoo, 2014).

Finally, adults may simply engage in different kinds of discourse surrounding God and germs that children are sensitive to. Guerrero, Enesco and Harris (2010) have argued that adults engage in discourse about germs in a “matter-of-fact” way. They argue that adult discourse takes the existence of germs for granted with statements that do not leave open a question of their existence; statements such as, “wash your hands before dinner to get rid of germs” or “cover your mouth when you cough so you don’t spread your germs.” However, children may observe conversations about “faith” in God; and/or



observe adults' express disagreement in the existence of God (Guerrero, Enesco, & Harris, 2010). After all, research on the percentage of adults that believe in God suggest that anywhere between 10 and 20% of adults do not believe, or are uncertain about the existence of God, and that number has risen slowly but linearly over the last several decades (Gallup, 2016; Pew Forum, 2015)

***Sources of cultural information.*** Information about scientific entities like germs are ubiquitous. Children are given cautionary information about hygiene and pathogen avoidance from educational, medical, food service, and children's media programming. Information sharing about concepts of God on the other hand are restricted by federal regulations in some forums (e.g., public school, public health establishments), and absent from other public forums because of a capitalist market orientation (i.e., businesses want to appeal to the broadest possible audience). For example, information about germs are routinely integrated into school settings—both to prevent the spread of illness among school children, teachers, and staff; and for the sake of keeping up with required curriculum (California Department of Education, 2009). Children may receive testimony from teachers about germs casually through being told to use hand sanitizer and/or avoid sneezing on one's peers. Additionally, scientific concepts are routinely taught as part of K-12 education in the form of lectures and activities. Information about religious entities such as God on the other hand, are not routinely integrated into secular or public school education per the separation of church and state. Teachers may causally mention it but promoting or showing a bias towards a particular religious' doctrine is legally prohibited; and therefore often approached with extreme caution, if the subject is broached at all.

Information about God is common in private religious schools of which less than 10% of children attend (Council for American Private Education, n.d.). Overall, while information about God and germs is likely to come from parents and families, there is a difference in the likelihood of children receiving information about God from non-family public sources.

***Motivations for behavioral engagement.*** Germ-related behaviors and God-related behaviors are engaged in for different reasons, and these different reasons may impact children's views about God and germs. Humans have a hypersensitivity toward the threat of contagion and automatically have a disgust reaction to things that are conceived of as being contaminated with germs (Tybur, Lieberman, & Griskevicius, 2009). As result of human disgust sensitivity and the germ theory of disease, germs are associated with rejection and avoidance (Shtulman, 2017). The behaviors (e.g., washing hands, disinfecting surfaces) commonly done associated with germs, are done with the purpose of eliminating them. The concept of God on the other hand, is often associated with increased prosocial behavior and cooperation (McCaffree, 2017; Shariff, Willard, Anderson, & Norenzayan, 2016). Importantly, religious rituals such as praying to God or attending church, are done as a signal or symbolic gesture of membership with the group that worships God (Sosis & Alcorta, 2004).

***Emotionality and the collective nature of behaviors.*** Germs and God can elicit thoughts and behaviors that differ in valence. For example, germs are more often than not, associated with something "bad," with negatively-charged emotions, and as interfering with health (Ergazaki, Saltapida, & Zogza, 2010; Shtulman, 2017). Even

though disgust can be an arousing experience, the behaviors performed in anticipation of, and in response to disgust and germs, are generally not. For example, washing one's hands, taking a morning shower, and/or doing the dishes, are not necessarily emotion-laden experiences; but rather, part of everyday subconscious habits (Wood, Quinn, & Kashy, 2002).

Activities related to God on the other hand, may be associated with strong positive emotions via collective ritual engagement. Religious activities which are performed to worship God, communicate with God, and signify group membership, generate something scholars refer to as, collective effervescence (Durkheim, 1912/2001; McCaffree, 2017). Collective effervescence is the overpowering emotional energy that is generated when individuals engage in synchronous, rhythmic, physical actions together as a group. These social ritual experiences are a central, fundamental component of religion. Whether it is singing songs at church service, dancing at a religious holiday event, singing prayers during a family dinner, or some other religious practice—collective effervescence serves as a positive reinforcing experience that children are engaged in. Although there are secular avenues for generating collective effervescence such as sporting events, music concerts and more; the collective nature of the activities engaged in that elicit this experience is not customary of germ-related behaviors (e.g., taking a shower, cleaning dishes), but it is for God-related behaviors (e.g., collective prayer, singing, dancing). At an individual level, priming someone with thoughts of God may stimulate anxiety and negative affect, but ritual engagement provides emotional

benefits (e.g., Norton & Gino, 2014; Shariff, Willard, Andersen, & Norenzayan, 2016; Toburen & Meier, 2010; Wiegand & Weiss, 2006).

***Conception of consciousness.*** God and germs differ in how individuals conceptualize them as agents. Although both are commonly conceptualized as causal mechanisms (Kalish, 1996; Wallston et al., 1999), children and adults do not equally conceptualize them as having minds. Children and adults readily grant God mind-dependent properties such as thoughts, and emotions (Shtulman, 2008; Shtulman & Lindeman, 2015). Children and adults do not readily grant germs mind-dependent properties (Solomon & Cassimatis, 1999).

***Social identity.*** As a religious concept, God is a representation or symbol of a shared identity—that of a religious worshipper of God—and often reinforced with collective rituals (Durkheim, 1912/2001). Germs on the other hand, are not symbolic of a shared social or cultural identity. Durkheim (1912/2001) theorized that social life was literally split into two profoundly different domains, one that concerned *sacred* things, and another that concerned *profane* things. While the sacred concerns ideas that are socially reinforced by collective rituals and elicit strong emotions; the profane concerns ideas that are simply not entrenched with social identification and may be part of emotionally neutral habitual behaviors. As Durkheim (1912/2001) stated, “...sacred things are cast into an ideal and transcendent setting, while the material world is left entirely to others” (p. 38). One way to formulate the differences laid out here from ontological status to social identity, is to place God and germs into Durkheim’s categorization; God is sacred and germs are profane.

*In summary.* The inclusion of God and germs in research on children's anthropomorphic reasoning and fantasy-reality judgements is common (e.g., Harris et al., 2006; Shtulman, 2008; Solomon & Cassimatis, 1999). They are commonly included because concepts of God and germs have important commonalities and dissimilarities that serve to assist with general predictions about: (a) how children and parents reason about abstract concepts, and (b) what factors are important for parent-child correspondence of concepts. For example, the different emotions that are elicited by thoughts and behaviors regarding God and germs, may inform how and why children anthropomorphize them. For example, children readily associate good or positive things with themselves, and are reluctant to associate bad or negative things with themselves (Mezuliu, Abramson, Hyde, & Hankin, 2004); if children associate germs with negative affect, they may be less likely to anthropomorphize them by virtue of that. As another example, germs are reinforced in school settings while God is generally not. As a result, a conceptual model that examines the influence of parents may be more applicable to (i.e., explain more variance in) concepts of God, than to concepts of germs. Finally, it was noted above that God and germs differ in terms of where information about them comes from, but one important commonality of these concepts is that children learn about them with the help of other people via social learning processes.

### **Socialization**

Cognitions in general, and about agents in particular, do not develop in a vacuum. Instead, concepts develop as part of dialectic processes between biological maturation and the sociocultural context in which thinking occurs, an enculturation of

thought. The sociocultural context includes, but is not limited to, the practices, structures, and values of the community (and larger society) of which the individual resides (Gauvain, 2001).

Jean Piaget reasoned that children acquire knowledge through their interactions with objects (Piaget, 2006). For example, Sommerville, Woodward, and Needham (2005) found that infants appear to perceive of the goals of another person when the observation of another person's actions (e.g., reaching for an object) are followed by the infant's experience of doing that same action (i.e., reaching/grasping an object). However, many other studies have demonstrated that children also learn through social processes whereby cognitive (and emotional) development is mediated through the assistance (in some cases through scaffolding or other forms of social learning) of cultural experts (i.e., parents, older siblings) (Chen, 2012; Gauvain & Perez, 2015; Turnbull, Carpendale, & Racine, 2009). Socialization refers broadly to a wide range of processes that integrate children into their surrounding community(ies) via children's own adoption of the values and practices of community members (Gauvain & Perez, 2015; Schaffer, 2006).

**Social learning processes.** There are different social learning processes that facilitate the connection between children's cognitive development and their culture. Four social learning processes outlined by Gauvain and Nicolaidis (2014) include: behavioral observation, sharing of knowledge in reciprocal interaction, explicit efforts to instruct and transmit knowledge, and participation in cultural activities. The social learning process of *observing* involves the child watching the behavior of another person.

The person the child is watching may or may not be aware they are being observed by the child, and the person may or may not have a relationship with the child. For example, a child may observe a religious leader saying a prayer with another family. The social learning process of *sharing* involves information being passed between the child and another person. It involves a reciprocal relationship between the child and the other person such that the child can be the one who (a) shares information and/or (b) is the person with whom information is being shared. The social learning process of *transmitting* involves a more experienced person (i.e., cultural expert) intentionally teaching the less experienced person (i.e., child) a skill or behavior. In this scenario, the experienced person works directly to support and guide the child until she or he can do whatever it is on their own. This form of social learning may occur in formal and/or informal setting (i.e., in and/or outside a classroom environment). The social learning process of *participating* involves the child being directly engaged in a cultural activity with an experienced cultural member (or members).

These four processes of enculturation do not exist in isolation, they often co-occur. In other words, children likely experience all of them, and a social learning experience may start out one way, and morph into another. For example, a young child may begin watching an older sibling practice a ritual dance, and upon noticing their younger sibling observing them, the older sibling may begin to directly engage and teach their younger sibling how to do the dance. These four social learning mechanisms serve a prominent role in shaping the daily lives of children.

An important facet of social learning processes is testimony. Children learn concepts, in part, through observing how other people use words in different contexts and then gradually learn to use them in similar ways (Hampton, 2015). The testimony of others serves as one source of information for children about the world around them, particularly a source for children concerning phenomena that they cannot experience directly on their own via perceptual observations (e.g., sight, touch; Harris & Koenig, 2006). Testimony can serve as a powerful influence on children's reasoning. For example, children are more likely to state that invisible entities are real when those entities are endorsed by adults via discourse with children, and discourse between adults observed by children (Guerrero, Enesco, & Harris, 2010).

Testimony consists of communication from one person to another. Testimony can be made second, or even third hand; and can be verbal or non-verbal. For example, buildings and other symbols may implicitly communicate to children who or what is valued and important in their culture (Harris & Koenig, 2006). If a child grows up in a community with a lot of libraries, museums, and other sources of learning, the child is likely to perceive that other people in the community value education. Behaviors also implicitly communicate to children what is and what is not important. For example, in order for children to see religion as important, their parents must not only verbally express that to be the case, parents must also behave as if it is, by doing things like praying and attending church regularly (Bader & Desmond, 2006). Testimony is a source of learning about concepts for both children and adults, albeit not always an accurate one.



Jaswal and Perez-Edgar (2014) argued that humans are predisposed to believe testimony, that children have a “belief bias,” and that skepticism requires inhibitory control and revision of one’s own beliefs requires cognitive effort. Jaswal, Croft, Setia, and Cole (2010) explored children’s bias to believe and 3-year-old children were more inclined to follow misleading verbal testimony of a researcher than misleading non-verbal testimony (i.e., in the form of a pointing arrow). These findings highlight the power of verbal testimony in shaping our conceptions and behaviors. In other words, the children searched for a sticker under a cup that the researcher told them to search under, even after the researcher had been wrong every time. Believing the testimony of others is an efficient means to learn about our environment because first-hand observational experiences can be time-consuming (e.g., gathering evidence and reports of consensus), impossible without cultural tools (e.g., seeing the structure of DNA), and in some cases impossible even with tools (e.g., history). Therefore, even though children can be skeptical of testimony and pick up on logical inconsistencies (e.g., Doebel, Rowell, & Koenig, 2016), children also can be overly reliant on testimony. This is especially the case with concepts that never have a material referent for children to explore with their own senses, as is the case with concepts of God, but not germs.

**Socialization settings.** The social learning mechanisms described above highlight that the processes of cultural transmission do not merely, “consist in ‘downloading’ concepts from one mind to [the child’s mind]. It requires inferential processes, whereby [children] attend to cues in other people’s behavior, infer their communicative intentions and build concepts on the basis of what they inferred” (Boyer,

2000, p. 195). Children come into contact with many different types of socializing agents (e.g., parents, siblings, teachers) and in many different settings. Bronfenbrenner (1994) posited that the exogenous influences on children's development can be broken up into five nested systems: microsystem, mesosystems, exosystems, macrosystems, and chronosystems. The one of particular focus in the current study is the microsystem. The microsystem is composed of environments that the child comes into direct face-to-face contact with. The microsystem consists of patterns of, "activities, social roles, and interpersonal relations experienced by the child" (Bronfenbrenner, 1994, p. 5). Microsystem level settings include, but are not limited to: the child's home, school, and religious organization (e.g., church, mosque). In this system during early childhood, family members, particularly parents, and the home setting continue to play an important role in children's socialization.

**Parent-related factors.** Parent context in this study refers to factors that influence children's development that would not exist without the parents. Parent context includes (a) characteristics of the parent (e.g., their beliefs, thinking style) and (b) the social learning opportunities parents create. Parent context factors are important for what and how children learn about God and germs. For example, a parent's belief in God influences the type of information the parent will convey to the child about God, the ways in which the parent will disseminate that information, and how often. Parents likely spend more time trying to teach their children about God if they believe that God is real. Parent context constitutes an important facet of the microsystem in which development occurs (Bronfenbrenner, 1994).

Previous research shows that consistency between parents' own beliefs and behaviors, along with the quality of the parent-child relationship, are important to successful transmission of beliefs and behaviors (Bader & Desmond, 2006; Voas & Crockett, 2005). Research also shows that having a secure attachment to parent may positively impact children's perceptions of the trustworthiness of parental testimony (Corriveau, et al., 2009). However, previous research on the development of God- and germ-related concepts, have largely been descriptive about the influence of parents, rather than delineating the conditions in which parents are more or less influential. Previous research has not focused on predictors of the correspondence (i.e., the degree of relatedness) between parents and children's concepts.

***Supernatural-religious concepts.*** Religion regulates the behaviors in which one ought to engage, and the cognitions that one ought to have; in other words, religion and culture, "function as normative cognition systems that govern beliefs and behaviors" (Jensen, 2013, p. 48). As with any social institution, religion disseminates information through enculturation processes (i.e., social learning) that operate through social actors (e.g., religious leaders, educators, followers and their families) (Rogoff, Moore, Correa-Chavez, & Dexter, 2015). For example, a child may learn how to pray to God from instruction from his or her parents and/or by observing a congregation of people engaged in prayer. Religion provides opportunities for people to mimic and synchronize with each other (e.g., by attending religious services, engaging in religious rituals in the home), thereby facilitating the dissemination of expectations for beliefs and behavior (i.e., norms) within and across generations of group members.

Research has highlighted the role of parent-context factors on the transmission of religiosity. There are studies that show that the incorporation of children in religious practices by their parents is important for later religiosity provided that children are securely attached to their parents, family dynamics are stable (i.e., no divorce), both parents are in agreement about religious behaviors and beliefs, and parents' religious views match their behaviors (i.e., parents believe religion is important and they engage in religious behaviors that demonstrate that such as engagement in costly rituals like prayer and church attendance) (Bader & Desmond, 2006; Corriveau, et al., 2009; Granqvist & Kirkpatrick, 2004; Hoge, Petrillo, & Smith, 1982; Myers, 1996).

Previous work on children's nonspontaneous concepts specifically however, have not always explored the role of parents in depth, or as a research objective. For example, Lane and colleagues (2010; 2012) found evidence to support the importance of religious exposure on children developing conception of God as infallible. They interviewed children from schools but had incomplete background information from parents (e.g., on parental beliefs and children's exposure to religious activities). Only 62% of parents of the religiously-schooled sample, and 68% of the secularly-schooled sample returned their parent questionnaire. Such a low return rate inhibits the inferences that researchers can make about the role of parents in their children's concept formation. A recent study, that had 100% of parents respond to questionnaires, directly linked parents' views of religious activities (i.e., prayer) to children's views of God (Richert, Shaman, Saide & Lesage, 2016). Parents who endorsed the possibility that prayer is performed in order to communicate with God had children that viewed God as more

humanlike. Even though, Richert and colleagues (2016) provided the correlation between parents' views of God and children's views of God; they did not examine the ways in which their concepts differed or what predicted differences. Given these gaps in past research on religious concepts like God, this study examined both parents' and children's concepts in relation to each other.

*Natural-scientific concepts.* Children are exposed to a lot of messages about germs from media, family, school, medical settings, and more. They hear pragmatic messages such as “cover your mouth when you cough”, “sneeze into your elbow so you don't spread germs”, and “wash your hands” (California Department of Education, 2009). Parents are influential in children's understanding of germs. Specifically, parents socialize children into practices meant to help children avoid germs (e.g., hygiene), and parents demonstrate for children what should count as targets of disgust (e.g., expired food, public restrooms) (Guerrero, Enesco, & Harris, 2010; Stevenson, Oaten, Case, Repacholi, & Wagland, 2010).

Repulsion to things and situations that may contain pathogens are partially informed by our evolutionary endowment. Avoiding pathogens holds survival advantages and indeed a relatively ancient part of our brain called the insular cortex is active when humans experience disgust or witness it in other people (Corradi-Dell'Acqua, Tusche, Vuilleumier, & Singer, 2016). Humans though are not always very accurate about what should be considered disgusting (i.e., associated with pathogens, with germs). For example, pasteurization is very new in human history, but very important for reducing the number of people that suffer from milk-borne illnesses. The

greater the amount of time it takes to consume unpasteurized/ raw milk after it is milked from the cow, the longer bacteria has to incubate, which is why heating it (i.e., pasteurization) to kill the bacteria is so important. Yet consumption of unpasteurized milk still causes foodborne illness every year in the United States (Center for Disease Control, n.d.).

There is variation in disgust sensitivity among adults, and between children and adults (Stevenson, et al., 2010; Tybur, Bryan, Lieberman, Hooper, & Merriman, 2011). Children do not always find the same things unpleasant the way adults do. For example, young children report being more willing to consume food that has been contaminated by the presence of insects (though later removed), as compared with older children and adults (Shtulman, 2017). Parents socialize their children's disgust responses. Parents that report greater disgust sensitivity are also more likely to involuntarily communicate that disgust by way of facial expressions with their children (Stevenson, et al., 2010). Children likely observe their parent's expressions of disgust and take that as cues about what should be considered "disgusting." Notably, parents demonstrate more avoidant behavior and express greater disgust (via facial expressions) to young children (as oppose to older children) even after controlling for parents own reported disgust sensitivity (Stevenson et al., 2010).

### **Characteristics of the Child**

Characteristics of the child, interact with the child's sociocultural context to facilitate social learning (Bronfenbrenner, 1994; Tomasello, 1999). Attributes of the

child that facilitate their ability to learn from others include social cognitive skills, executive functioning, and working memory.

**Social Cognition.** Social cognition generally, and theory-of-mind more specifically, has been directly linked to learning. For example, in a non-social domain, Sabbagh and colleagues (2010) found a relationship between cognitive adaptation and theory-of-mind, such that children with better theory-of-mind were better able to adapt behaviorally to a task that required them to lift a heavy object. Additionally, better performance on theory-of-mind tasks has been linked to selective social learning; children who are better at mental-state reasoning are also better at assessing and endorsing verbal information from knowledgeable people in their environment. In a study by Brosseau-Liard, Penney, and Poulin-Dubois (2015), 3- and 4-year-old children who scored higher on a theory-of-mind battery also demonstrated a preference to learn from accurate informants. In their study, children were presented with two puppets that both labeled familiar objects, one puppet tended to be accurate while the other puppet tended to be inaccurate. The puppets then labeled novel objects, and children with higher theory-of-mind scores were more likely to preferentially choose the puppet that was accurate during the familiar object phase of the task.

More accurate reasoning about mental-states has also been linked to a greater relationship between parents and children's concepts. Saide and Richert (2017) found that children who passed both knowledge-ignorance and false-belief tasks (as oppose to one or neither) had a conception of God that was similar to their parent's conception, this was the case even after controlling for the age of the child. In other words, children's

theory-of-mind moderated the relationship between parent's concept and child's concept, such that children able to understand that humans can have limited access to knowledge and false-beliefs were more likely to have a conception of God that mirrored their parent's conception of God.

Social cognition refers to the aspects of cognition dedicated to how humans understand themselves and other agents in the context of a social environment (Schaffer, 2006). Socio-cognitive skills (e.g., language, ability to engage in joint attention, and synchronous action) enable the processing of social information (Gauvain, 2001; Schaffer, 2006). Children develop such skills over time, and each skill contributes to an improved understanding on the part of the child about agents. One core socio-cognitive ability is theory-of-mind. Theory-of-mind refers to the aspect of a person's social cognition that relates to her or his ability to make accurate inferences about the desires, intentions, beliefs, perceptions, and knowledge of another person (Flavell, 2004).

Typically-developing (i.e., excluding autistic and deaf children) children's theory-of-mind becomes more accurate during the first years of life, and scholars have traced a discernable serial progression in children's reasoning about minds (e.g., Wellman & Liu, 2004; Wellman, Fuxi, & Peterson, 2011). Infants begin by distinguishing between agents and objects (i.e., animate and inanimate objects) and then appear to grasp that actions by agents are driven by goals. This is followed by the understanding that people can (a) have different desires (i.e., diverse desires), (b) have different beliefs about the same object (i.e., diverse beliefs), (c) be knowledgeable or ignorant about something (i.e., knowledge-ignorance), (d) hold a false-belief about an object (i.e., false-belief), and (e)



think an object is something that it is not (i.e., appearance-reality). This list is in order from theoretically easiest, to theoretically hardest for children to comprehend. In other words, children understand diverse desires before they understand false beliefs (Peterson, Wellman, & Liu, 2005; Wellman, Cross, & Watson, 2001). In a meta-analysis by Wellman, Cross, and Watson (2001), there was an overall significant positive relationship between age and passing false-belief tasks.

Cross-cultural comparisons have found a similar general pattern in theory-of-mind development (e.g., Wellman, Fuxi, Liu, Zhu, & Liu, 2006). Wellman and colleagues (2006) compared Chinese children to English speaking children from Australia and the United States. They found a similar scaling pattern with one exception, whereas English speaking children first grasp that people can have diverse desires (i.e., the first step they seem to pass in the scale), Chinese children grasped knowledge-ignorance earliest. In study by Callaghan and colleagues (2005), children from five different cultures were assessed with the same theory-of-mind task and demonstrated age-related synchrony in the onset of false-belief understanding. Most children in the study across the five cultures (Canada, Peru, India, Somoa, and Thailand) failed to understand false-belief at 3 years but succeeded by 5 years-of-age. Another cross-cultural study compared 3- to 9-year-old children from Australia and Iran, assessing participants with a six-step scale (i.e., with an added sarcasm task). Shahaieian and colleagues (2014) found that Australian children demonstrated a greater understanding of diverse beliefs and diverse desires whereas Iranian children demonstrated a greater understanding of knowledge access and sarcasm.

Taken together, the research on theory-of-mind development point to the important role that social cognition plays in the learning of nonspontaneous concepts from cultural experts (e.g., parents) to cultural novices (e.g., children). Executive function and working memory are important in children's developing theory-of-mind ability, and are also related to children's selective trust in informants (Carlson & Moses, 2001; Doebel, Rowell, & Koenig, 2016). Executive functioning and working memory may also serve as important aspects of the child that facilitate social learning processes.

**Executive Function.** Executive functioning skills are important for children's learning in general. Executive functioning makes it possible for children to control their thoughts (i.e., cognitive control) and behaviors (i.e., behavioral control) enough to process and recall information, and to solve problems (Bjorklund, 2012). Executive functioning skills are important to children's ability to learn from knowledgeable people (i.e., cultural experts) in their environment, and positively predicts the age at which children develop accurate reasoning in the biological domain (Doebel, Rowell, & Koenig, 2016; Zaitchik, Iqbal, & Carey, 2014).

Executive functioning is important for social learning, in that such skills make it possible for children to suppress biases in lieu of new potentially contradictory data. For example, children's executive functioning skills are positively related to age and theory-of-mind (Sabbagh, Xu, Carlson, Moses, & Lee, 2006). Children with more developed executive functioning skills are better able to suppress their beliefs, desires, intentions, and knowledge, in order to assess those things in other people (i.e., they have more accurate theories about other minds). Cross-cultural research with preschoolers from

China and the United States found a positive relationship between executive functioning (i.e. ability to inhibit dominant response) and theory-of-mind (Sabbagh, et al., 2006). Individual differences in executive functioning skills predicted increased performance on theory-of-mind tasks. However, Sabbagh and colleagues (2006) argued for the emergence hypothesis; in other words, executive functioning skills seem to be necessary but insufficient for theory-of-mind ability. Executive functions foster children's capacity for mental-state reasoning, but experiences (e.g., having older siblings) practicing mental-state reasoning are likely a partial mediator of the relationship between executive functioning and theory-of-mind. As discussed earlier, children who more accurately reason about the minds of others are also better at assessing knowledgeable people in their environment (Brosseau-Liard, Penney, & Poulin-Dubois, 2015), highlighting the relationship between executive functioning, theory-of-mind, and social learning.

The type of executive functioning skills found to enable theory-of-mind development are inhibitory control processes, specifically, conflict inhibition (Carlson & Moses, 2001). Conflict inhibition refers to the ability to suppress a dominant or intuitive initial response in favor of a less dominant reflective response.

**Working memory.** In addition to the ability to suppress conflict, working memory is also related to improved reasoning about mental states (Carlson & Moses, 2001). Working memory involves both the storage of information and the ability to transform the information held in the short-term memory system (Bjorklund, 2012). In one study, children were shown a video of two informants with different information about a stimulus. In one condition there was an inconsistent testimonial; for example,

“Today I saw a ball that was the biggest ball ever and it was the smallest ball ever.” In another condition, there was a logically consistent statement from one of the informants; for example, “Today I saw a ball that was the biggest ball ever and it was the softest ball ever.” (Doebel, Rowell, & Koenig, 2016). The study found that during early childhood, executive function, and working memory predicted children’s ability to detect logical inconsistencies and conflict in the testimony of two unfamiliar informants.

### **Middle Childhood**

The current study focused on children between the ages of 5- and 8.9- years in order to capture and consider important cognitive developmental changes that are occurring during this period. The transition between early and middle childhood is a period of development associated with important changes in children’s understanding of mental-states, causal reasoning, biology, and the borders between fantasy and reality (Boerger, 2011; Shtulman, 2009; Shtulman, 2017; Wellman & Liu, 2001; Wellman & Liu, 2004). For example, between 6- and 9- years of age, children become increasingly aware of the need to justify one’s thoughts on whether or not events could occur and whether or not certain psychological and biological properties could be attributed to entities such as people or fantastical beings (i.e., also called children’s possibly judgements; Shtulman, 2009). Between the ages of 5- to 7- years children undergo cognitive reorganization (e.g., more regulatory control; Bjorklund, 2012), it is also a period marked by greater responsibility for children in and outside of the home (Lancy & Grove, 2011). In the state California, children enter kindergarten at approximately age 5.

## Summary

Taken together, the scholarship reviewed here highlights that enculturation of abstract concepts involves the interaction between attributes of the child (e.g., age, reasoning heuristics) and factors that are extrinsic to the child, such as parent context (i.e., attributes of the parent and social learning opportunities they create) (Gauvain & Nicolaidis, 2014; Vygotsky, 1978). The research reviewed here suggests that social learning processes and socializing agents such as parents, are important for children's development of concepts of God and germs specifically (Bader & Desmond, 2006; Ergazaki, Saltapida, & Zogza, 2010; Guerrero, Enesco, & Harris, 2010; Stevenson et al., 2010). Even though there is very little research on (a) the specific ways in which parents and children's concepts differ, and (b) which predictors of correspondence in conceptual content between parent-and-child are most impactful; previous research suggests that parents and children's concepts do differ and that there are factors (e.g., ritual engagement, testimony) that may increase similarity between them. The current study sought to fill these gaps in the understanding of parent-child conceptual correspondence. Although God and germs differ in several keys ways (e.g., affect, sources of socialization, perceptions of consciousness), their similarly abstract nature, and development via social learning make them useful targets for a study on how parent context influences conceptual correspondence. Inclusion of a scientific concept is also important because scientific concepts may not be learned about from family (e.g., parents) to the same extent that religious concepts are.

## **Chapter 2: Current Study**

### **Research Objectives and Hypotheses**

This study had three primary research objectives; the first two outlined below served as building blocks for the third and final objective of chief interest in this study on correspondence between parents and children's concepts.

#### **First Objective (RO1)**

The first objective of this study was to answer the following: to what extent do children between 5- and 8.9- years of age, and one of their parents, conceptualize natural and supernatural entities as having body- and mind-dependent properties? A natural-scientific (i.e., germ) and supernatural-religious entity (i.e., God) were chosen for examination; and both qualify as nonspontaneous concepts (Vygotsky, 1978).

**Supernatural entity hypotheses.** It was hypothesized that: (1) On average, parents will state that God exists, in real life (Pew Forum, 2012; Harris et al., 2006). (2) On average children will state that God is real (Blair, et al., 1980; Guerrero, Enesco, & Harris, 2010). (3) Overall, parents will state that God has mind-dependent, but not body-dependent properties (Shtulman & Lindeman, 2015). (4) Overall, children will assign God both mind- and body-dependent properties (Shtulman, 2008; Heiphetz, Lane, Waytz, & Young, 2016). (5) Children's concept of God will vary across age; older children will assign God fewer body-dependent and more mind-dependent properties to God than younger children. Finally, (6) children's concepts will not vary across gender; there will not be differences in conception between male and female children.

**Natural entity hypotheses.** It was hypothesized that: (1) On average, parents will state that germs do exist, in real life (Harris et al., 2006). (2) On average children will state that germs are real (Blair, et al., 1980; Guerrero, Enesco, & Harris, 2010). (3) Overall, parents will state that germs have body, but not mind-dependent properties (Solomon & Cassimatis, 1999). (4) Overall, children will state that germs do not have body or mind-dependent properties; and younger children will be mixed in their reports of whether or not germs are alive (Solomon & Cassimatis, 1999). (5) Children's concepts will vary across age; older children will be more likely to state that germs have body-dependent properties. Finally, (6) children's concepts will not vary across gender; there will not be differences in conception between male and female children.

### **Second Objective (RO2)**

The second objective of this study was to answer the following: to what extent do children's concepts of God and germs correspond with their parents' concepts?

**Supernatural entity hypotheses.** It was hypothesized that: (1) children will assign God more body- and mind-dependent properties than their parents (Shtulman, 2008). (2) The relation (i.e., correlation) between parents' and children's concepts of God will be positive and small in size (Saide & Richert, 2017).

**Natural entity hypotheses.** It was hypothesized that: (1) children will assign germs more mind-dependent properties, and fewer body-dependent properties than their parents (Solomon & Cassimatis, 1999). (2) The relation (i.e., correlation) between parents' and children's concepts of germs will be positive and small in size (per what has been found in the case of other concepts; Saide & Richert, 2017).

### **Third Objective (RO3)**

The third objective of this study included two parts. The first part of RO3 sought to answer the following: does the hypothesized conceptual model of parent-child correspondence significantly predict correspondence for the two concepts (i.e., of God and germs) explored in RO1 and RO2? The conceptual model predicting correspondence included: (a) characteristics of the parent (e.g., beliefs, behaviors), (b) social learning opportunities created by the parent (e.g., frequency of engagement of children by parents in activities and discourse about the entity), (c) children's beliefs about the reality status of entities, (d) parent-reported importance of the entity concept for their child, and (e) attributes of the child including: theory-of-mind ability, age, and executive functioning.

Three sets of relationships were hypothesized: First, characteristics of the parent would positively relate to and predict: (a) parent reported entity salience, (b) parental engagement of children in activities and/or discourse pertaining to the entities, and (c) children's belief in the existence of the entities (e.g., Bader & Desmond, 2006; Gelman, 2009; Harris et al., 2006; Richert, Saide, Lesage, & Shaman, 2016). Second, the engagement of children by parents in activities and/or discourse about the entity, parent reported salience, and the child's belief in the existence of the entity would mediate the relationship between characteristics of the parent and correspondence (e.g., Harris & Koenig, 2006; Gauvain & Nicolaidis, 2014). Third, attributes of the child (e.g., theory-of-mind ability, age) would moderate the relationship between: (a) entity salience and correspondence, and (b) child engagement and correspondence (e.g., Brosseau-Liard, Penney, & Poulin-Dubois, 2015; Doebel, Rowell, Koenig, 2016).



Characteristics of the parent related to God include: parents’ belief in the existence of God, parents’ affiliation with a religion, frequency of parents’ engagement in religious practices, and parents’ analytical thinking style. Characteristics of the parent related to germs include: parents’ belief in the existence of germs, parents’ pathogen sensitivity, parents’ contamination sensitivity, and parent’s analytical thinking style. See conceptual model in Figure 1 below for a visual representation of these hypothesized relations.

It was not the intention of this study to directly compare concepts of God and germs. As a result, the aim of the second part of RO3 was to *describe* whether or not the same mediators and moderators were important to the correspondence of the religious-supernatural (i.e., God) concept and to the natural-scientific (i.e., germs) concept.

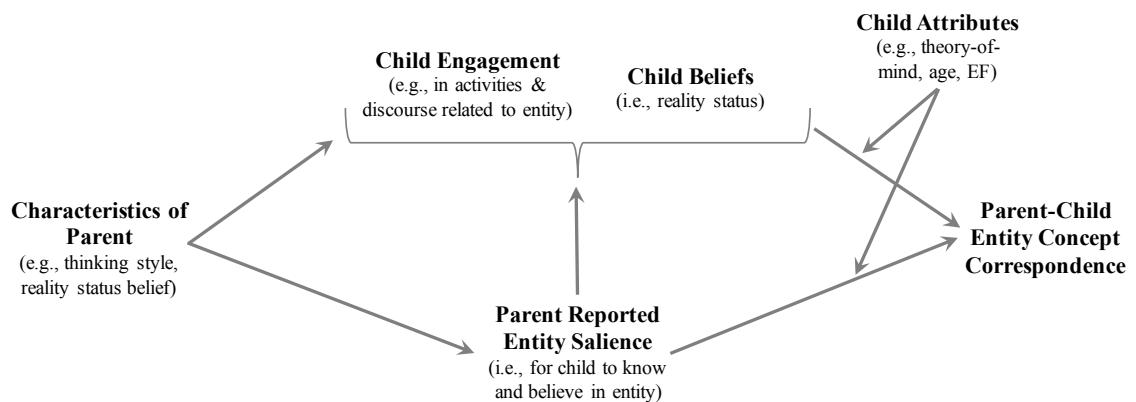


Figure 1. *Conceptual model examined in research objective three*

It was hypothesized that overall the conceptual model being tested would fit best for the religious-supernatural entity as compared with the scientific-natural entity. Two lines of reasoning support this hypothesis: First, school context factors are not incorporated into the above model and likely serve as a primary source of information

about germs. Although teacher-student conceptual correspondence is important, it is outside the scope of this particular study meant to unpack parent-child correspondence. This model (in Figure 1) is specifically aimed at examining the role of parent context factors, but information about germs may be more distributed across socializing agents than information about God (as explained in chapter 1). Second, behaviors related to God and germs differ qualitatively; while the former is sacred and set apart, the latter is profane and part of everyday habits done subconsciously (e.g., Durkheim, 1912/2001; Guerrero, Enesco, & Harris, 2010).

## **Methods**

### **Participants**

129 parent-child dyads participated. Dyads were excluded from analysis if the accompanying adult was not the child's parent (e.g., grandparent) as was requested at the time of scheduling the family ( $n = 3$ ), the child did not assent to be video recorded ( $n = 1$ ), there was a video malfunction during the interview ( $n = 1$ ), or the child did not pay attention during the interview ( $n = 1$ ). As a result, the sample examined here includes 123 parent-child dyads. There were 123 children and 99 parents because some parents brought in more than one child; as a result, analyses with parent-only responses have fewer participants as compared with the child-only analyses. Children were between 5.14 and 8.85 years of age ( $M = 6.903$ ,  $SD = 1.129$ , 51.2% female). Parents were between 21 and 54 years of age ( $M = 34.55$ ,  $SD = 5.497$ , 88.6% mothers). Children were ethnically diverse: Hispanic/Latino ( $n = 53$ ), White ( $n = 27$ ), African American ( $n = 14$ ), Asian ( $n =$

5), Other ( $n = 1$ ) and multi-ethnic ( $n = 23$ ). Parents reported that 15% of children were attending parochial schools at the time of the study.

Dyads were recruited with the intention of having an even distribution of children across the age range of 5 to 9 years. This was done in order to capture variation in children's developing executive functioning, and understanding of mental-states, biology, and the borders between fantasy and reality. As discussed in the introduction, these areas of cognition show marked increases in complexity and accuracy across early childhood. They are also helpful to children in learning and problem-solving tasks (Bronfenbrenner, 1994; Sabbagh et al., 2010; Shtulman, 2017; Woolley & Brown, 2015; Zaitchik, Iqbal, & Carey, 2014). This recruitment goal resulted in 59 children in the younger half of the age distribution (i.e., were between 5.14-years and 6.9-years-of-age) and 64 children in the older half of the age distribution (i.e., were between 7.0-years and 8.85-years-of-age). Dyads were also recruited with the intention of having a similar number of children from religious ( $n = 59$ ) and relatively secular ( $n = 64$ ) parents in order to capture variation in the frequency of engagement in ritual practices, which has been found to be important in previous research on children's developing concepts of God (e.g., Richert, Saide, Lesage, & Shaman, 2016). Dyads were placed in the category of "secular" when parents stated that they engage themselves and their children in religious practices less than once per month. This is one way to parse out religiosity and secularity (McCaffree, 2017).

## **Materials**

**Parents.** Parents filled out an online questionnaire on Qualtrics via a laptop that was provided to them. The questionnaire was broken into four sections that were

counterbalanced across participants. The first section comprised demographic questions (e.g., age, ethnicity, religious participation) on the parent and their child. The second section included all germs-related concept questions. The third section measured the parent's analytical thinking style, mental-state reasoning, and disgust avoidance. The last section included all God-related concept questions. See Appendix A for copy of questionnaire.

**Children.** The child interview was broken into four sections that were counterbalanced across participants according to their age and gender. The first section measured whether the child believed God, germs, and their mother is real or pretend. The second section included all germs-related questions. The third section measured the child's theory-of-mind, working memory, and executive functioning. The last section included all God-related questions. See Appendix B for copy of interview.

## **Measures**

**Concept of God and germs.** The following compose the variables related to how children and parents conceptualize the two entity types: (a) God, and (b) germ.

**Entity concept domains.** Children and parents were asked the same series of questions on the properties of God and germs. Forced-choice questions concerning biological, physical, psychological, and ontological properties have been used for a wide range of entities including germs and God (e.g., Boerger, 2011; Shtulman, 2008; Shtulman & Lindeman, 2015). Parents and children were asked ten questions broken into two subdomains: (1) psychological or mind-dependent properties, and (2) physiological or body-dependent properties. These properties may or may not be directly talked about

in social discourse; regardless of that, whether or not these entities have the ten properties asked about can be inferred by children based on what they hear (i.e., via testimonials), and observe (i.e., via rituals) about the entity from others.

The psychological (i.e., mind-dependent) properties included the following five items: to know things, want something, see, smell, and make plans. The physiological (body-dependent) properties included the following five items: alive, eat food, breathe, grow old, have bones. These properties were chosen from the 23 psychological and 25 physiological properties used in Shtulman and Lindeman (2015). Answer options were dichotomous: “no” [0] (i.e., does not have the property) or “yes” [1] (i.e., does have the property). Scores for each entity were summed and then divided by the number of questions/items for a proportion score of the properties granted. This resulted in four variables for parents and four variables for children; two variables that represent their concept of each entity for each subdomain—body-dependent and mind-dependent. See Table 1 for means and standard deviations.

***Parent-child entity correspondence.*** In order to examine the correspondence of conceptual content between parents and their children, a correspondence score was created for each entity concept (i.e., germs, God), and each entity concept subdomain (i.e., body-dependent, mind-dependent). This created four total correspondence variables. For each entity property question (e.g., to eat food, to know things), if parents and children answered the same way, they received a score of “1” to indicate correspondence; and if they did not answer the same way, they received a “0” to indicate a lack of correspondence. For example, if the child and their parent both said “no” or

both said “yes” when asked, “Can God want something?” then the dyad was given a “1” for correspondence. If either the child or their parent said “no” while the other said “yes”, the dyad was given a “0” to represent a lack of correspondence. Scores were then summed for a total correspondence score and each correspondence variable could have ranged from 0 to 5. See Table 1 for means and standard deviations.

Table 1  
*Entity Concept Scores*

	Entity	Subdomain	M	SD	Range
Concept Score (proportion): Parents	God	Body-Dependent	0.235	0.281	0-1
		Mind-Dependent	0.697	0.382	0-1
	Germs	Body-Dependent	0.531	0.252	0-1
		Mind-Dependent	0.188	0.278	0-1
Concept Score (proportion): Children	God	Body-Dependent	0.694	0.287	0-1
		Mind-Dependent	0.841	0.255	0-1
	Germs	Body-Dependent	0.267	0.248	0-1
		Mind-Dependent	0.263	0.298	0-1
Parent-Child Correspondence Score (summed)	God	Body-Dependent	2.197	1.535	0-5
		Mind-Dependent	3.325	1.667	0-5
	Germs	Body-Dependent	3.008	1.292	0-5
		Mind-Dependent	3.517	1.347	0-5

***Spontaneous entity concept.*** In order to contextualize the close-ended entity concepts described above, parents and children were both asked two open-ended questions, “please tell us about God” and “please tell us about germs”. Parents wrote their answers in the questionnaire while children verbalized their answer to the researcher interviewing them. Both parents’ and children’s answers were coded for the number of mind-dependent and body-dependent properties they spontaneously stated in their response. Properties were only counted if the participant stated a property that was *not* a

property (e.g., eat food, know things) they were asked about in the close-ended section of the questionnaire or interview. Examples of properties assigned to God include: has a heart, listens, dances, forgives, protects, and is male. Examples of properties assigned to germs include: can jump, has a shape, and can grow in size.

Two variables were derived from parents' responses to the God question; one for the number of mind-dependent ( $M = .706$ ,  $SD = .749$ ) and one for the body-dependent ( $M = .550$ ,  $SD = .659$ ) properties attributed to God. Two variables were derived from parents' responses to the germs question; one for the number of mind-dependent ( $M = .000$ ,  $SD = .000$ ) and one for the number of body-dependent ( $M = .030$ ,  $SD = .171$ ) properties attributed to germs. Two variables were derived from children's responses to the God question; one for the number of mind-dependent ( $M = .854$ ,  $SD = .864$ ) and one for the number of body-dependent ( $M = .408$ ,  $SD = .667$ ) properties attributed to God. Two variables were derived from children's responses to the germs question; one for the number of mind-dependent ( $M = .300$ ,  $SD = .920$ ) and one for the number of body-dependent ( $M = .838$ ,  $SD = .1.040$ ) properties attributed to germs.

**Parent Variables.** The following compose additional parent-relevant variables used in this study from the parent questionnaire.

**Religious behaviors.** The frequency by which parents generally engage in religious practices was measured with two questions on how often they attend events sponsored by a religious organization (e.g., attend church services), and engage in private religious practices (i.e., at home). Responses ranged from "never" [0] to "multiple times

a day” [6] and were averaged for an overall *Parent Religious Behaviors* score ( $M = 1.828$ ,  $SD = 1.891$ , Cronbach’s  $\alpha = .806$ ).

***Religious belonging.*** Parents were asked, “What is your religious affiliation?” Parents were then broken into two groups: (a) affiliated with a religion (score of 1,  $n = 64$ ), and (b) not affiliated with a religion (score of 0,  $n = 25$ ). 10 parents did not report whether or not they have a religious affiliation.

***Reality status (i.e., belief in entity).*** Parents were asked two five-point Likert-type questions on whether they believe God and germs exist in real life. Responses ranged from, “Definitely does not exist” [-2] to “Definitely does exist” [+2] (God:  $M = 1.04$ ,  $SD = 1.411$ ; Germs:  $M = 1.970$ ,  $SD = 0.172$ ).

***Disgust sensitivity.*** Parents’ concern with and belief in the disgust quality of germs was measured with two scales. The first was a *Pathogen-based sensitivity* scale that measured concern with disgust elicitors (i.e., Three Domain Disgust Scale from Tybur, Bryan, Lieberman, Hooper, & Merriman, 2011; Tybur, Lieberman, & Griskevicius, 2009). The pathogen domain subscale used contained seven statements pertaining to: (a) standing near someone with body odor, (b) shaking hands with someone with sweaty palms, (c) stepping on dog poop, (d) touching someone’s bloody cut, (e) seeing mold on leftovers, (f) sitting next to someone with red sores, and (g) seeing a cockroach run across your floor. Parents answered on a seven-point Likert scale by stating that they believed the scenario was “not at all disgusting” [0] to “very disgusting” [6]. Answers to the seven questions were averaged for an overall measure of pathogen-based sensitivity ( $M = 4.891$ ,  $SD = 1.164$ , Cronbach’s  $\alpha = .740$ ).



The second was a *Contamination-based sensitivity* scale, which measured a person's disgust reactions when they perceive the threat of the transmission of contagions in situations such as: (a) touching a public toilet seat, (b) eating food cooked by someone with a cold, (c) drinking from the same glass as someone else, (d) eating something shaped like dog poop, and (e) inflating a condom with your mouth (Olatunji, et al., 2007). This scale consisted of five questions, two with answer categories of true/false and three on a three-point Likert scale that ranges from “not disgusting” [0] to “very disgusting” [1]. Answers to the five questions were summed for an overall measure of contamination-based disgust ( $M = 2.297$ ,  $SD = 1.303$ ).

***Analytical thinking style.*** Parents' analytical thinking style was measured with the *Cognitive Reflection Test (CRT)*. The CRT was originally designed by Frederick (2005) to assess cognitive reflection. It assesses individuals' ability to suppress an intuitive and spontaneous wrong answer in favor of a reflective and deliberative correct answer. For example, the question might be, “A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost?” The correct answer is 5 cents but the intuitive answer more commonly given is 10 cents.

The original measure had three questions. Additional questions were added by Toplak, West, and Stanovich (2014). All seven questions were used as the revised version known as the CRT7. For each question, parents received a score of 1 for a correct answer or a 0 for an incorrect answer. Scores were summed and they could have ranged from 0 to 7 ( $M = 1.470$ ,  $SD = 1.643$ ).

***Salience.*** Parents were asked two questions on how important it is for their child to: (1) know, and (2) believe in each entity. Responses ranged from “Not important” [0] to “Extremely important” [3]. Responses to the two questions were averaged for an overall Salience score (God:  $M = 1.808$ ,  $SD = 1.021$ , Cronbach’s  $\alpha = .933$ ; Germs:  $M = 2.192$ ,  $SD = .654$ , Cronbach’s  $\alpha = .831$ ).

**Child Variables.** The following variables were used from the child interview and were related to the child’s behaviors as reported by parents.

***Reality status (i.e., belief in entity).*** Children were asked about the reality status of the entities with wording typical of previous studies (e.g., Woolley & Brown, 2015). Children were asked a question on whether God is real or pretend, and a question on whether germs are real or pretend. Responses ranged from, “Pretend, really sure” [-2] to “Real, really sure” [+2] (God:  $M = 1.210$ ,  $SD = 1.467$ ; Germs:  $M = 1.460$ ,  $SD = 0.147$ ).

***Behaviors.*** Parents answered questions about how often they engage in activities related to the entity with their child, and how often they talk to their children about the entity. Parents were asked how often they talk to their children about God; referred to as *God Talk*. Responses ranged from “never” [0] to “multiple times a day” [5] ( $M = 2.422$ ,  $SD = 1.487$ ). Parents were asked how often they engage in activities or routines related to God, with their child; referred to as *God-related Behaviors*. Responses ranged from “never” [0] to “multiple times a day” [5] ( $M = 2.008$ ,  $SD = 1.696$ ). Parents were asked how often they talk to their children about Germs; referred to as *Germ Talk*. Responses ranged from “never” [0] to “multiple times a day” [5] ( $M = 3.520$ ,  $SD = 1.169$ ). Parents were asked how often they engage in activities or routines related to germs, with their

child; referred to as *Germ-related Behaviors*. Responses ranged from “never” [0] to “multiple times a day” [5] ( $M = 3.951$ ,  $SD = 1.366$ ).

***Social cognition.*** Children’s social cognition was measured by five tasks that assess different aspects of a child’s developing theory-of-mind, these aspects have been found to increase in difficulty: (1) knowledge access, (2) false-belief: change-in-location, (3) false-belief: unexpected contents, (4) hidden emotions, and (5) sarcasm. The following tasks were given in the same order for every child, and the doll or protagonist asked about was presented as the same biological sex as the child. In other words, if the child was male, then a male doll named “Tom” was used; if a female child, then a female doll named “Sally” was used.

(1) *Knowledge-access task*: This task measured the child’s understanding that when someone see things, they know them; but if that person does not see them, they will not know them (Shahaeian et al., 2011). This task followed the same procedure, scoring, and similar stimuli as Peterson, Wellman, and Liu (2005).

(2) *False-belief/change-in-location task*: This task measured the child’s understanding that people can have incorrect beliefs (Shahaeian et al., 2011). In this task the child must understand that even though they know where an object is hidden, the protagonist (i.e., doll) has an incorrect belief about where it is hidden. In this task, there were two boxes, a blue one and a white one. The child was told that the doll likes to hid their favorite toy in the blue box. The doll then left and the toy was moved to the white box. The child was asked where the doll will look for their toy when they return (similar to Wimmer & Perner, 1983; designed to parallel tasks taken from Peterson, Wellman, &

Liu, 2005). In this task, the movement of the toy was presented to the child as a deliberate act of deception.

(3) *False-belief/unexpected contents task*: This task measured the child's understanding that people can have incorrect beliefs (Shahaeian et al., 2011). This task followed the same procedure and scoring as Peterson, Wellman, and Liu (2005), with the exception that what was hidden in the Band-Aid box was birthday candles instead of a pig figurine.

(4) *Hidden emotions task*: This task measured the child's understanding that people may intentionally choose to hide how they really feel inside by presenting a different facial expression (Shahaeian et al., 2011). This task followed the same procedure of Peterson, Wellman, and Liu (2005), and the scoring of Peterson, Wellman, and Slaughter (2012). For the scoring of this task, there was a primary and secondary coder that coded independently. Agreement with the primary coder was 100% for the open-ended answers given by the children for the justification control questions.

(5) *Sarcasm task*: This is an advanced theory-of-mind task that measures the child's understanding of irony and sarcasm. This task followed the same procedure and scoring adapted from Wellman and Liu (2004) by Peterson, Wellman, and Slaughter (2012). For the scoring of this task, there was a primary and secondary coder that coded independently. Agreement with the primary coder was 85% for the open-ended answers given by the children for the justification control questions. As a result, there was a third coder that reconciled disagreement.

Children received a score for whether or not they “failed” [0] or “passed” [1] each task. Although researchers have found that typically-developing children often pass these tasks in the progression noted above, this is not necessarily the case for all children. Cross-cultural research in particular, reveals variation among children with regard to the order by which they pass these tasks (e.g., Shahaieian, et al., 2014; Wellman, et al., 2006). As a result, regardless of order passed, scores for each of the five tasks were summed for each child, for an overall theory-of-mind score, which ranged from “passed no tasks” [0] to “passed all tasks” [5]. See Table 2 for descriptive statistics of the pass frequency and percentages for each task; 89.43% of children passed in a pattern consistent with Wellman and Liu’s (2004) scale. In other words, most children passed the theorized easier tasks before the harder ones.

Table 2  
*Theory-of-mind Tasks: Pass Statistics*

	Younger Group		Older Group	
	5.0-6.9 years ( <i>n</i> = 59)		7.0-8.9 years ( <i>n</i> = 64)	
Age Mean (SD)	5.880	(.534)	7.847	(.567)
Pass KA	<i>n</i> = 57	(96.6%)	<i>n</i> = 64	(100%)
Pass FB Location	<i>n</i> = 50	(84.7%)	<i>n</i> = 63	(98.4%)
Pass FB Contents	<i>n</i> = 37	(62.7%)	<i>n</i> = 56	(87.5)
Pass HE	<i>n</i> = 6	(10.2%)	<i>n</i> = 45	(70.3%)
Pass SARC	<i>n</i> = 4	(6.8%)	<i>n</i> = 15	(23.4%)
Mean ToM Total (SD)	2.61	(.983)	3.80	(.839)

**Conceptual information sources.** In order to contextualize where children are receiving information about God and germs, children were asked open-endedly, “How did you learn about germs/God?”. A follow-up question of, “Who told you about germs/God?” was added if children did not answer the first prompt. The first source they

named (e.g., mom, TV show) was recorded. Additionally, children were asked whether or not the following sources have ever talked to them about God/germs: (a) friends, (b) teacher, (c) sibling (if applicable), (d) grandparent, (e) parent, and (f) anyone else.

Children answered “yes” [1] or “no” [0].

***Working memory.*** Children’s working memory was measured with a *forward digit recall task* that requires children to recall a series of digits in order. The task used followed the same protocol as Gathercole, Pickering, Ambridge, and Wearing (2004). Each digit was spoken by the researcher at the rate of one digit per second. Lists consisted of numbers that ranged from 1 to 9 and were constructed randomly. Children were taught the task in a practice session. For the test session, each list length had no more than six trials. If the child got four sequences in a given list length correctly, then the researcher increased the difficulty by one additional number. The task began with single-digit lists and progressed in difficulty until three lists/trials of a particular length were recalled incorrectly. The child’s score was the highest number of digits they could correctly repeat back four times ( $M = 4.77$ ,  $SD = 1.230$ ).

***Executive functioning.*** There was no comparable CRT measure widely available for use with children; as a result, several measures of children’s executive functioning were used instead. Children’s conflict inhibition was measured with a Flanker task. The *flanker task* was originally designed by Eriksen and Eriksen (1974) and is a commonly used measure of conflict inhibition. This task was given to each child via the validated NIH Toolbox using an iPad (Weintraub et al., 2013). The NIH Toolbox calculates

several different scores, the one used for this study is the one uncorrected for the age of the child ( $M = 82.43$ ,  $SD = 13.829$ ).

Children's executive functioning was also measured with a *backward digit recall task*. A backward digit span task requires children to recall sequences of digits in reverse order; thereby requiring information to not only be stored in short-term memory (as is tested in the forward digit task) and transformed in some way, but also to hold those numbers in mind while suppressing the tendency to repeat the numbers in order. The tasks used followed the same protocol as Gathercole et al. (2004). The child was asked to recall a spoken list of numbers in reverse order (e.g., 2,5,4 is then recalled as 4,5,2).

Similar to the forward digit span task, each digit was spoken by the researcher at the rate of one digit per second. Lists consisted of numbers that ranged from 1 to 9 and were constructed randomly. Children were taught the task in a practice session. For the test session, each list length had no more than six trials. If the child got four sequences in a given list length correctly, then the researcher increased the difficulty by one additional number. The task began with single-digit lists and progressed in difficulty until three lists/trials of a particular length are recalled incorrectly. The child's score was the highest number of digits they could correctly repeat back in reverse four times ( $M = 2.66$ ,  $SD = .950$ ).

## **Procedure**

Parent-child dyads were recruited for a study on children's learning and reasoning about abstract phenomena. Parent-child dyads were contacted from a participant database pool. Families were added to the database one of the following two ways: (1)

interested parents initiated contact because of advertisements they saw online or flyers posted in the surrounding community, or (2) parents provided their contact information after they were told about participating in research by a research assistant while attending local events in the community. Each child was interviewed in an on-campus laboratory or in the family's home. The accompanying adult completed a questionnaire in an adjacent room on a laptop computer provided to them by the researcher. The parent questionnaire took approximately 30 minutes to complete. Children were interviewed by a researcher for approximately 45 minutes. The parent received \$15 per child, and each child received a small toy (\$1 value). In addition to parental consent, all children separately assented to being interviewed and video recorded.

### **Siblings**

Parents filled out a survey for each of their children. 19% of families in this study had more than one child participate. Inclusion of siblings could inflate findings as the answers between siblings may be more related to each other (relative to non-siblings) because of the increases in genetic similarity between them and the shared environment created by their shared parents. In order to explore this possibility, analyses were first run using one child per family. A random number generator was used to determine which sibling in the family would be included. These preliminary analyses did not indicate meaningful differences in findings (i.e., in direction or statistical significance). As a result, the following analyses make use of the full sample with all 123 children and their parents.



### **Missing Data**

Some cases are missing for variables used in the following analyses. Three parents did not answer all ten of the concept of germs questions, seven children did not have Flanker scores, six parents did not have working memory scores. Analyses make use of all participants with usable data for the measures described above; as a result, sample size may vary slightly in the analyses below.

## Chapter 3: Results

### Research Objective 1 (RO1) Results

#### Analysis plan

In order to examine the research objective 1 hypotheses, the following planned statistical tests were run in addition to simple descriptive statistics: (1) One-Sample t-tests to examine beliefs about the reality status of entities, (2) Chi-Square goodness of fit tests to examine patterns in responses to the entity concept questions among parents and children, and (3) Independent-Samples t-tests to examine differences between younger and older children, and male and female children in overall mind- and body-dependent concepts of God and germs.

#### Supernatural Entity Concepts

**Reality status.** Consistent with previous research (e.g., Fahmy, 2018), a One-Sample t-test revealed the majority of parents reported that God exists,  $t(98) = 6.331, p < .001, d = .636$ . Although parents reported on average that they believed God exists, 26.8% of parents reportedly did not believe God exists or were not sure that God exists (i.e., an “I don’t know” response). Also consistent with previous research (e.g., Guerrero, Enesco, & Harris, 2010), a One-Sample t-test revealed children reported in the affirmative that they believed God is real,  $t(122) = 9.159, p < .001, d = .825$ . 80.5% of children reported that they believed God is real. A Paired-Samples t-test revealed that parents ( $M = 1.04, SD = 1.41$ ) and children ( $M = 1.21, SD = 1.47$ ) did not significantly differ from each other in their reports of God’s reality status,  $t(122) = 1.077, p = .284$ .

**Parents' concepts of God.** Consistent with prior research (e.g., Shtulman & Lindeman, 2015), parents stated that God has mind-dependent, but not body-dependent, properties. There was an exception with the property of being “alive”, such that parents were no more likely to state “yes” or “no” that God is alive,  $\chi^2 = 2.273, p = .132$ . Parents were also no more likely to state “yes” or “no” that God “can smell”,  $\chi^2 = 0.253, p = .615$ . See Table 3 for a summary of the pattern of responding to the individual properties.

Table 3  
*Parents' Concept of God*

GOD		Yes	%	No	%	$\chi^2$
Physiological (body-dependent)	1. Grow Old	3	3.0	96	97.0	87.364**
	2. Eat Food	13	13.3	85	86.7	52.898**
	3. Breathe	28	28.6	70	71.4	18.000**
	4. Bones	15	15.3	83	84.7	47.184**
	5. Alive	57	57.6	42	42.4	2.273
Body-Dependent Properties Proportion: $M = .235, SD = .281$						
Psychological (mind-dependent)	1. Know	80	80.8	19	19.2	37.586**
	2. Want	68	68.7	31	31.3	13.828**
	3. See	76	76.8	23	23.2	28.374**
	4. Smell	47	47.5	52	52.5	0.253
	5. Make Plans	74	74.7	25	25.3	24.253**
Mind-Dependent Properties Proportion: $M = .694, SD = .382$						

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

The mean proportion score for body-dependent properties of God was .235 ( $SD = .281$ ); parents on average assigned God between 1 and 2 body-dependent properties out of the 5 asked about. The mean proportion score for mind-dependent properties of God was .697 ( $SD = .382$ ); parents on average assigned God between 3 and 4 of the 5 mind-dependent properties asked about. The overall proportion score for mind-dependent properties of God was positively correlated with body-dependent properties of God, the

correlation was large,  $r = .498, p < .001$ . Lastly, a Paired-Samples t-test revealed a large significant difference between how parents conceptualized God's body- and mind-dependent properties overall,  $t(97) = 13.227, p < .001, d = 1.368$ . Parents assigned God considerably more mind-dependent properties.

**Children's concepts of God.** Consistent with prior research (e.g., Shtulman, 2008), children stated that God has mind-dependent and body-dependent properties. Children consistently assigned God with these properties overall, with the exception of the question pertaining to whether or not God can grow old. Children did not significantly differ in picking "yes" or "no" responses to whether God can grow old,  $\chi^2 = 0.073, p = .787$ . Children did significantly pick "yes" for the majority of questions on God: eating food, breathing, having bones, being alive, knowing things, wanting things, seeing things, smelling things, and making plans to do things. See Table 4 for a summary of the pattern of responding to the individual properties.

The mean proportion score for body-dependent properties of God was .694 ( $SD = .287$ ); children on average assigned God between 3 and 4 body-dependent properties out of the 5 asked about. The mean proportion score for mind-dependent properties was .841 ( $SD = .255$ ); children on average assigned God 4 out of the 5 mind-dependent properties asked about. The proportion score for mind-dependent properties of God was positively correlated with body-dependent properties of God, the correlation was large,  $r = .598, p < .001$ . Lastly, a Paired-Samples t-test revealed a medium significant difference between how children conceptualized God's body- and mind-dependent properties overall,  $t(122)$

= 6.641,  $p < .001$ ,  $d = .542$ . Children assigned God more mind-dependent properties; but still assigned God more than half the number of body-dependent properties asked about.

**Among children: Gender and age.** The following summarizes the results of independent-samples t-tests conducted between the younger ( $M_{age} = 5.880$ ,  $SD = .534$ ) and older children ( $M_{age} = 7.847$ ,  $SD = .567$ ) in the study; and between male and female children. As hypothesized, there was a significant difference in concept of God between the age groups. Older children ( $M = .906$ ,  $SD = .201$ ) assigned God significantly more mind-dependent properties than younger children ( $M = .770$ ,  $SD = .287$ ) did,  $t(121) = -3.033$ ,  $p = .003$ ,  $d = 0.548$ . This difference was medium in size.

Table 4.  
*Children's Concept of God*

GOD		Yes	%	No	%	$\chi^2$
Physiological (body- dependent)	1. Grow Old	60	48.78	63	51.22	0.073
	2. Eat Food	89	72.35	34	27.64	24.593**
	3. Breathe	104	84.55	19	15.44	58.740**
	4. Bones	91	73.98	32	26.01	28.301**
	5. Alive	83	67.48	40	32.52	15.033**
Body-Dependent Properties Proportion: $M = .694$ , $SD = .287$						
Psychological (mind- dependent)	1. Know	114	92.68	9	7.31	89.634**
	2. Want	96	78.04	27	21.95	38.707**
	3. See	112	91.05	11	8.94	82.935**
	4. Smell	97	78.86	26	21.13	40.984**
	5. Make Plans	98	79.67	25	20.32	43.325**
Mind-Dependent Properties Proportion: $M = .841$ , $SD = .255$						

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

In contrast, younger ( $M = .671$ ,  $SD = .315$ ) and older ( $M = .716$ ,  $SD = .259$ ) children in the study did not significantly differ in the attribution of body-dependent properties of God,  $t(121) = -.858$ ,  $p = .393$ ,  $d = -.156$ . There were not significant

differences in concepts between male ( $M = .850$ ,  $SD = .259$ ) and female ( $M = .832$ ,  $SD = .252$ ) children for mind-dependent properties of God,  $t(121) = -0.396$ ,  $p = .693$ ,  $d = .070$ . There were not significant differences in concepts between male ( $M = .707$ ,  $SD = .283$ ) and female ( $M = .683$ ,  $SD = .291$ ) children for body-dependent properties of God,  $t(121) = -0.465$ ,  $p = .643$ ,  $d = .084$ .

**Open-ended responses.** In response to the open question “tell me about God,” children rarely described God as having body-dependent or mind-dependent properties. Children assigned God less than 1 mind-dependent property on average ( $M = .837$ ,  $SD = .866$ ) and even fewer body-dependent properties ( $M = .400$ ,  $SD = .660$ ) on average. In other words, although children had assigned God a high number of mind-dependent and body-dependent properties in the structured part of the interview, children did not assign these properties to God in the free-response portion of the interview.

Parents responded similarly to their open-response question. They assigned God less than 1 mind-dependent property on average ( $M = .706$ ,  $SD = .749$ ) and even fewer body-dependent properties ( $M = .550$ ,  $SD = .659$ ) on average. In other words, although parents assigned God a high number of mind-dependent properties in the close-ended part of the questionnaire, they did not assign mind-dependent properties in the free response/open-ended portion. Consistent with the close-ended part of the questionnaire, parents did not assign God body-dependent properties in the free response.

### **Natural Entity Concepts**

**Reality status.** Consistent with what was hypothesized, 100% of parents reported that they believed germs exist. A One-Sample t-test confirmed this response rate was

significantly higher than chance,  $t(98) = 113.750, p < .001, d = 11.051$ . Also consistent with previous research (e.g., Harris et al., 2006), a One-Sample t-test indicated children were above chance in reporting that they believed germs are real,  $t(122) = 9.159, p < .001, d = 1.275$ . 88% of children reported that they believed germs are real. Parents and children significantly differed in their reports of the reality status of germs. Although both groups stated on average that germs exist, a Paired-Samples t-test revealed that parents ( $M = 1.97, SD = .17$ ) were significantly more confident in the existence of germs than their children ( $M = 1.46, SD = .15$ ),  $t(122) = 4.871, p < .001, d = .457$ .

**Parents' concepts of germs.** Consistent with prior research (e.g., Solomon & Cassimatis, 1999), parents were more likely to state that germs have body-dependent, but not mind-dependent, properties. In the exploratory analysis of parents' concepts of germs, parents were mixed on whether or not germs have body-dependent properties, with a significant number of parents stating that germs are alive but do not have bones. Additionally, parents were not more likely to state "yes" or "no" to the questions of whether or not germs breathe ( $p = .840$ ), eat food ( $p = .153$ ) or grow old ( $p = .106$ ). Parents were less mixed on whether or not germs have mind-dependent properties, with parents stating that germs do not know things, see things, smell things, or make plans to do things. Parents were not more likely to state "yes" or "no" to the question of whether or not germs want things,  $\chi^2 = 3.646, p = .056$ . See Table 5 for a summary of the pattern of responding to the individual properties.

The mean proportion score for body-dependent properties of germs was .531 ( $SD = .252$ ); parents on average assigned germs between 2 and 3 body-dependent properties

out of the 5 asked about. The mean proportion score for mind-dependent properties of germs was .188 ( $SD = .278$ ); parents on average assigned germs less than 1 out of the 5 mind-dependent properties asked about. The proportion score for mind-dependent properties of germs was positively correlated with body-dependent properties of germs, the correlation was moderate-to-large,  $r = .446, p < .001$ . Lastly, a Paired-Samples t-test revealed a large significant difference between how parents conceptualized germs' body- and mind-dependent properties overall,  $t(97) = -12.272, p < .001, d = -1.293$ . Parents assigned germs considerably more body-dependent properties.

Table 5.  
*Parents' Concept of Germs*

GERMS		Yes	%	No	%	$\chi^2$
Physiological (body-dependent)	1. Grow Old	57	58.2	41	41.8	2.612
	2. Eat Food	55	57.3	41	42.7	2.042
	3. Breathe	50	51.0	48	49.0	0.041
	4. Bones	3	3.0	96	97.0	87.364**
	5. Alive	95	96.0	4	4.0	83.646**
Body-Dependent Properties Proportion: $M = .531, SD = .252$						
Psychological (mind-dependent)	1. Know	15	15.3	83	84.7	47.184**
	2. Want	40	40.4	59	59.6	3.646†
	3. See	11	11.2	87	88.8	58.939**
	4. Smell	16	16.3	82	83.7	44.449**
	5. Make Plans	11	11.2	87	88.8	58.939**
Mind-Dependent Properties Proportion: $M = .188, SD = .278$						

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

**Children's concepts of germs.** Consistent with prior research (e.g., Solomon & Cassimatis, 1999), children generally stated that germs do not have mind-dependent or body-dependent properties. Overall, children did not assign germs body-dependent properties with a significant number of them stating that germs do not grow old, do not



each food, do not breathe, and do not have bones. Children were not more likely to state “yes” or “no” to the question of whether or not germs are alive,  $\chi^2 = 3.585, p = .058$ . Overall, children did not assign germs mind-dependent properties, with a significant number of children stating germs do not know things, want things, see things, smell things, or make plans to do things.

The mean proportion score for body-dependent properties of germs was .267 ( $SD = .248$ ); children on average assigned germs between 1 and 2 body-dependent properties out of the 5 asked about. The mean proportion score for mind-dependent properties of germs was .263 ( $SD = .298$ ); children on average assigned germs between 1 and 2 mind-dependent properties out of the 5 asked about. See Table 6 for summary of means and standard deviations.

Table 6.  
*Children's Concept of Germs*

GERMS		Yes	%	No	%	$\chi^2$
Physiological (body- dependent)	1. Grow Old	26	21.13	97	78.86	40.984**
	2. Eat Food	26	21.13	97	78.86	40.984**
	3. Breathe	31	25.20	92	74.79	30.252**
	4. Bones	9	7.31	114	92.68	89.634**
	5. Alive	72	58.53	51	41.46	3.585†
Body-Dependent Properties Proportion: $M = .267, SD = .248$						
Psychological (mind- dependent)	1. Know	23	18.69	100	81.30	48.203**
	2. Want	41	33.33	82	66.66	13.667**
	3. See	38	30.89	85	69.10	17.959**
	4. Smell	28	22.76	95	77.23	36.496**
	5. Make Plans	32	26.01	91	73.98	28.301**
Mind-Dependent Properties Proportion: $M = .263, SD = .298$						

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

The proportion score for mind-dependent properties of germs was positively correlated with body-dependent properties of germs, the correlation was large,  $r = .675$ ,  $p < .001$ . Lastly, a Paired-Samples t-test revealed an insignificant difference between how children conceptualized germs' body- and mind-dependent properties overall,  $t(122) = -.161$ ,  $p = .873$ ,  $d = .015$ . Children did not assign germs a different proportion of mind- and body-dependent properties on average.

**Among children: Gender and age.** The following summarizes the results of Independent-Samples t-tests conducted between the younger ( $M_{age} = 5.880$ ,  $SD = .534$ ) and older children ( $M_{age} = 7.847$ ,  $SD = .567$ ) in the study; and between the male and female children. Contrary to the hypothesis, there were not significant differences in concepts of germs between the younger and older children. Younger ( $M = .227$ ,  $SD = .233$ ) and older ( $M = .303$ ,  $SD = .257$ ) children in the study did not significantly differ in concept of germs' body-dependent properties,  $t(121) = -1.713$ ,  $p = .089$ ,  $d = -.309$ . Younger ( $M = .261$ ,  $SD = .300$ ) and older ( $M = .266$ ,  $SD = .298$ ) children also did not differ in concept of mind-dependent properties,  $t(121) = -.085$ ,  $p = .932$ ,  $d = -.017$ . There were not significant differences in concepts between male ( $M = .277$ ,  $SD = .319$ ) and female ( $M = .251$ ,  $SD = .278$ ) children for mind-dependent properties,  $t(121) = -0.480$ ,  $p = .632$ ,  $d = .087$ . There also were not significant differences in concepts between male ( $M = .290$ ,  $SD = .251$ ) and female ( $M = .244$ ,  $SD = .245$ ) children for body-dependent properties,  $t(121) = -1.019$ ,  $p = .310$ ,  $d = .185$ .

**Open-ended responses.** In response to the open question, "tell me about germs," children did not describe germs as having body-dependent or mind-dependent properties.

Children assigned germs less than 1 mind-dependent property on average ( $M = .300$ ,  $SD = .920$ ) and less than 1 body-dependent property ( $M = .838$ ,  $SD = 1.04$ ) on average.

Consistent with what they reported in the structured part of the interview, children did not assign germs mind- or body-dependent properties in the free response portion.

Parents responded similarly to their open-response question. They assigned germs zero mind-dependent property on average ( $M = .000$ ,  $SD = .000$ ) and much less than 1 body-dependent property ( $M = .030$ ,  $SD = .171$ ) on average. Somewhat inconsistent with the close-ended part of the questionnaire, parents did not assign germs body-dependent properties in the free response outside of the ones that were asked about in the closed-ended portion.

### **Children's age and the relationship between God and germs**

Interestingly, there were significant correlations between children's concept of God and concept of germs among younger children. The correlation between younger children's concept of germs' mind-dependent properties and children's concept of God's mind-dependent properties was positive and moderate in size,  $r = .326$ ,  $p = .012$ . The correlation between younger children's concept of germs' body-dependent properties and children's concept of God's body-dependent properties was positive and moderate in size,  $r = .387$ ,  $p = .002$ . The correlation between older children's concept of germs' and God's mind-dependent properties was small and not significant,  $r = .189$ ,  $p = .136$ . The correlation between older children's concept of germs' and God's body-dependent properties was small and not significant,  $r = .161$ ,  $p = .202$ .

## **RO1 Summary**

**Supernatural entity concepts: God.** Both parents and children, on average, conceptualized God as real and existing. Parents and children did not differ from each other in their reported belief in the reality of God. The proportion of parents that reported the believed in God's existence in this study, however, was somewhat lower than nationally representative samples and polls of California adults. Whereas 72.3% of parents believe in God's existence in the current study, other polls place that number between 79-and-89% (e.g., Gallup, 2016).

There was a large significant difference between how parents conceptualized God's mind- and body-dependent properties. Parents on average stated that God has mind-dependent, but not body-dependent properties, which is consistent with the findings of Shtulman and Lindeman (2015). There was a significant difference between how children conceptualized God's mind- and body-dependent properties. Though children stated on average that God has both mind- and body-dependent properties, they granted God significantly more mind-dependent properties. Children's conceptualization of God as having mind-and body-dependent properties is consistent with prior research among non-Muslim children (e.g., Richert, Shaman, Saide, & Lesage, 2016; Shtulman, 2008). There were not significant differences in concepts between male and female children; in other words, there was no effect of gender. Although there were no differences in attributions of properties to God by child gender, there were differences by age. Younger children assigned God fewer mind-dependent properties than older children, but younger and older children did not differ in their attribution of body-dependent properties to God.

Overall, parents and children did not grant God body- or mind-dependent properties in the open-response question. This is largely inconsistent with how parents responded to the forced-response (i.e., close-ended) questions about God where parents' conceptualized God as having mind-dependent properties and children conceptualized God as having both mind- and body- properties

**Natural entity concepts: Germs.** Both parents and children, on average, conceptualized germs as real and existing. Parents were more confident in the existence of germs than their children were. There was a large significant difference in how parents conceptualized the body- and mind-dependent properties of germs; they assigned God significantly more body-dependent properties. This is consistent with prior research by Solomon and Cassimatis (1999).

Children, on average, did not assign germs body-dependent or mind-dependent properties; and, there was no significant difference between how they conceptualized the two subdomains. There were not significant differences in concepts between male and female children; or between younger and older children. In other words, there was not an effect of age or gender on concepts of germs. Previous research suggests that the older children in the study would have been more likely to grant germs body-dependent properties (per Solomon & Cassimatis, 1999) but this was not the case. Overall, parents and children did not grant germs body- or mind-dependent properties in the open-response question. This is largely consistent with how they responded to the forced-response (i.e., close-ended) questions about germs.

## **Research Objective 2 (RO2) Results**

### **Analysis Plan**

In order to examine the research objective 2 hypotheses, the following planned statistical tests were run for each entity: (1) a series of Pearson's  $r$  correlations to examine the magnitude and direction of the relationships between parents' and children's concepts, (2) Paired-Samples  $t$ -tests between parents' and children's concept proportion scores and (3) One-Sample  $t$ -tests with a difference score to determine the size and direction of the differences between parents and children's concepts. Additionally, (4) Chi-Square goodness of fit tests examined whether or not parents and children were more or less likely to correspond for each property item, and finally, (5) a Paired-Sample  $t$ -test with the summed item-by-item correspondence scores for body- and mind-dependent properties examined which concepts parents' and children corresponded most on.

### **Supernatural Entity Concepts**

Contrary to what was hypothesized, parents' concept of God's mind-dependent properties was not significantly related to children's concept of God's mind-dependent properties ( $r = .114, p = .208$ ); and parents' concept of God's body-dependent properties was not significantly related to children's concept of God's body-dependent properties ( $r = -.009, p = .919$ ). This is also contrary to previous studies that found a small positive correlation (e.g., Saide & Richert, 2017).

After running the correlations, Paired-Samples  $t$ -tests were run to determine how parents' and children's concepts differed. For concept of God, parents ( $M = .698, SD = .381$ ) assigned God significantly fewer mind-dependent properties than their children ( $M$

= .841,  $SD = .255$ ) did,  $t(122) = -3.661$ ,  $p < .01$ ,  $d = .282$ . The difference between children's and parents' concept of God's mind-dependent properties was small. Parents ( $M = .246$ ,  $SD = .287$ ) assigned God significantly fewer body-dependent properties than their children ( $M = .695$ ,  $SD = .288$ ) did,  $t(121) = -12.147$ ,  $p < .01$ ,  $d = 1.111$ . The difference between children's and parents' concept of God's body-dependent properties was very large; they differed by over 1 standard deviation.

Another way to examine the size and direction between parents and children's concepts is to create a difference score. A *difference score* provides information on the overall size and direction of the difference between parents and children's concepts; in other words, it reveals whether parents or children assigned more properties on average. An analysis of a difference score also provides information on whether parents and children have a similar concept domain generally. For example, even if parents and children vary on which specific psychological properties (e.g., to know, to make plans) they conceptualize God as having, they may still both conceptualize God as having psychological properties on average.

Parents' concept scores (i.e., entity concept proportion scores created and described in RO1) were subtracted from their children's concept scores creating a difference score for God's mind-dependent properties ( $M = -.143$ ,  $SD = .433$ ) and God's body-dependent properties ( $M = -.449$ ,  $SD = .408$ ). A positive difference score indicates that parents assigned more properties than their children did on average. A negative difference score indicates that parents assigned fewer properties than their children did on average. Two One-Sample t-tests were run in order to examine if the size of the

difference between parents and children's scores was significantly different from zero. These tests corroborated the findings from the Paired-Samples t-tests run with the proportion scores. Children significantly assigned more mind-dependent properties to God, than their parents did,  $t(122) = -3.661, p < .01, d = -.331$ . The size of the difference was small. Children significantly assigned more body-dependent properties to God,  $t(121) = -12.147, p < .01, d = -1.101$ . The size of the difference was large.

The correlational analyses above demonstrate that parents and children's concepts were not related to each other. The Paired Samples t-tests, accompanying Cohen's  $d$  effect sizes, and One-Sample t-tests with the difference scores above demonstrate that parents and children's concepts significantly differ from each other. As a result, an item-by-item analysis was conducted to determine where, *within* each concept, parents and children were most likely and least likely to correspond.

**Correspondence.** In order to garner more information about the specific nature of parent-child correspondence for concepts of God, and to thus account for more variation in correspondence, item-by-item similarities were assessed. Parent-child correspondence was measured for each entity property question (e.g., to eat food, to know things); if a parent and their child gave the same answer (either both said "yes" or both said "no"), they received a score of "1" to indicate correspondence, and if they did not answer the same way (i.e., one said "yes" while the other said "no" to the question), they received a "0" to indicate a lack of correspondence. See Table 7 for a breakdown of the correspondence by each entity property item.



Table 7

*Item-by-item Parent-Child Correspondence: God Concepts*

		Does Correspond		Does Not Correspond		$\chi^2$
		<i>n</i>	%	<i>n</i>	%	
<b>Physiological (body-dependent)</b>	1. Grow Old	64	52.03	59	47.97	0.203
	2. Eat Food	44	36.07	78	63.93	9.475**
	3. Breathe	48	39.34	74	60.66	5.541*
	4. Bones	36	29.51	86	70.49	20.492**
	5. Alive	78	63.41	45	36.59	8.854**
Summed Total Correspondence Score: $M = 2.196$ , $SD = 1.535$						
<b>Psychological (mind-dependent)</b>	1. Know	101	82.11	22	17.89	50.740**
	2. Want	77	62.60	46	37.40	7.813**
	3. See	94	76.42	29	23.58	34.350**
	4. Smell	60	48.78	63	51.22	0.073
	5. Make Plans	77	62.60	46	37.40	7.813**
Summed Total Correspondence Score: $M = 3.325$ , $SD = 1.666$						

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

The following summarizes the Chi-Square goodness of fit tests that examined whether or not parents and children were more or less likely to correspond for each entity property item. Among the body-dependent properties asked about, parents and children corresponded most on whether or not God is alive (63% of dyads),  $\chi^2 = 8.845$ ,  $p < .01$ ; and corresponded least on whether or not God has bones (30% of dyads),  $\chi^2 = 20.492$ ,  $p < .01$ . Taking into account how parents and children separately responded to the concept questions explored in RO1 (see Tables 3 and 4), the item-by-item correspondence patterns here indicate that while both parents and children tended to say that God is alive, parents were more likely than their children to say that God does not have bones. Among the mind-dependent properties asked about, parents and children corresponded most on whether or not God can know things (82% of dyads),  $\chi^2 = 50.740$ ,  $p < .01$ ; and least on

whether or not God can smell things (51% of dyads),  $\chi^2 = 0.073, p = .787$ . Both children and parents tended to say that God can know things, but children were more likely than their parents to say that God can smell things.

Finally, the *total* item-by-item correspondence for each subdomain was calculated. The correspondence scores for the five body-dependent (physiological) properties were summed for each dyad ( $M = 2.196, SD = 1.535$ ) and the five mind-dependent (psychological) properties were summed for each dyad ( $M = 3.325, SD = 1.666$ ). This provided a more precise and informative measure of the degree to which parents and their children correspond, because the way the variables were created accounts for where children and parents specifically (i.e., on each item) vary within each concept subdomain. This created two total correspondence scores for concepts of God, one for mind-dependent properties and one for body-dependent properties. A Paired-Samples t-test revealed a moderate-to-large significant difference in correspondence between mind-dependent ( $M = 3.325, SD = 1.667$ ) and body-dependent ( $M = 2.197, SD = 1.535$ ) properties of God,  $t(121) = 5.593, p < .001, d = 0.695$ . Correspondence was significantly higher for concepts of God's mind-dependent properties than God's body-dependent properties.

### **Natural Entity Concepts**

Contrary to what was hypothesized, parents' concept of germs' mind-dependent properties was not significantly related to children's concept of germs' mind-dependent properties ( $r = .165, p = .070$ ), though the relation was trending. Parents' concept of germs' body-dependent properties was significantly related to children's concept of

germs' body-dependent properties ( $r = .189, p = .037$ ); the relation was small and positive. After running the correlations, Paired-Samples t-tests were run to determine how parents' and children's concepts differed as the correlations were either unrelated or the relationships were small in magnitude. Parents' and children's concepts significantly differed for both entity subdomains. For concept of germs, parents ( $M = .184, SD = .270$ ) assigned germs significantly fewer mind-dependent properties than their children ( $M = .261, SD = .299$ ) did,  $t(120) = -2.321, p = .022, d = .221$ . The difference between children's and parents' concept of germs' mind-dependent properties was small. In contrast, parents ( $M = .527, SD = .258$ ) assigned germs significantly more body-dependent properties than their children ( $M = .268, SD = .248$ ) did,  $t(120) = 8.855, p < .01, d = -.783$ . The difference between children's and parents' concept of germs' body-dependent properties was medium-to-large.

Difference scores were created for concepts of germs, with the same protocol and with the same rationale as the difference scores for concepts of God (outlined on page 77). Parents' concept scores (i.e., entity concept proportion scores created and described in RO1) were subtracted from their children's concept scores creating a difference score for germs' mind-dependent properties ( $M = -.077, SD = .368$ ) and germs' body-dependent properties ( $M = .259, SD = .322$ ). Two One-Sample t-tests were run in order to examine if the size of the difference between parents and children's scores were significantly different from zero. These tests corroborated the findings from the Paired-Samples t-tests above with proportion scores. Children significantly assigned more mind-dependent properties to germs, than their parents did,  $t(120) = -2.321, p = .022, d =$

-209. The size of the difference was small. Parents significantly assigned more body-dependent properties to germs, than their children did,  $t(120) = 8.855, p < .01, d = 0.805$ . The size of that difference was large.

The correlational analyses above demonstrate that parents and children's concepts were either weakly related or unrelated to each other. The Paired Samples t-tests, accompanying Cohen's  $d$  effect sizes, and One-Sample t-tests with the difference scores demonstrate that parents and children's concepts significantly differ from each other. As a result, an item-by-item analysis was conducted to determine where, *within* each concept, parents and children were most likely and least likely to correspond.

**Correspondence.** In order to garner more information about the specific nature of parent-child correspondence for concepts of God, and to thus account for more variation in correspondence, item-by-item similarities were assessed. The item-by-item correspondence for concepts of germs was created the same way as the correspondence for concepts of God described above (see page 78 and/or page 52 of the measures section for a detailed description). See Table 8 for a breakdown of the correspondence by each entity property item.

The following summarizes the Chi-Square goodness of fit tests that examined whether or not parents and children were more or less likely to correspond for each entity property item. Among the body-dependent properties asked about, parents and children corresponded most on whether or not germs have bones (92% of dyads),  $\chi^2 = 86.252, p < .01$ ; and corresponded least on whether or not germs grow old (52% of dyads),  $\chi^2 = 2.388, p = .122$ . Taking into account how parents and children separately responded to the

concept questions explored in RO1 (see Tables 5 and 6), both parents and children tended to say that germs do not have bones, but parents were more likely than their children to say that germs grow old. Among the mind-dependent properties asked about, parents and children corresponded most on whether or not germs can make plans (76% of dyads),  $\chi^2 = 33.574$ ,  $p < .01$ ; and least on whether or not germs want things (56% of dyads),  $\chi^2 = 1.829$ ,  $p = .176$ . Both children and parents tended to state that germs cannot make plans, but parents were more likely than their children to say that germs can want something.

Table 8  
*Item-by-item Parent-Child Correspondence: Germ Concepts*

		Does Correspond		Does Not Correspond		$\chi^2$
		<i>n</i>	%	<i>n</i>	%	
<b>Physiological (body-dependent)</b>	1. Grow Old	52	42.98	69	57.02	2.388
	2. Eat Food	61	51.26	58	48.74	0.076
	3. Breathe	64	52.89	57	47.11	0.405
	4. Bones	113	91.87	10	8.13	86.252**
	5. Alive	75	60.98	48	39.02	5.927*
Summed Total Correspondence Score: $M = 3.008$ , $SD = 1.292$						
<b>Psychological (mind-dependent)</b>	1. Know	92	76.03	29	23.97	32.802**
	2. Want	69	56.10	54	43.90	1.829
	3. See	82	67.77	39	32.23	15.281**
	4. Smell	87	71.90	34	28.10	23.215**
	5. Make Plans	93	76.23	29	23.77	33.574**
Summed Total Correspondence Score: $M = 3.516$ , $SD = 1.347$						

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

Finally, the *total* item-by-item correspondence for each subdomain was calculated. The correspondence scores for the five body-dependent (physiological) properties were summed for each dyad ( $M = 3.034$ ,  $SD = 1.267$ ) and the five mind-dependent (psychological) properties were summed for each dyad ( $M = 3.509$ ,  $SD = 1.351$ ). This provided a more precise and informative measure of the degree to which

parents and their children correspond, because the way the variables were created accounts for where children and parents specifically (i.e., on each item) vary within each concept subdomain. A Paired-Samples t-test revealed a moderate significant difference in correspondence between mind- and body-dependent concepts of germs,  $t(117) = -2.886, p = .005, d = -0.454$ . Correspondence was significantly higher for concepts of germs' mind-dependent properties than germs' body-dependent properties.

## **RO2 Summary**

All of the analyses presented here reveal that parents' and children's concepts of God and germs are similar to each other in ways consistent with what would be expected based on prior research in this area (e.g., Shtulman, 2008; Solomon & Cassimatis, 1999).

For concepts of the supernatural entity, the correlational analyses demonstrated that parents and children's concepts of God were not significantly related to each other. However, the Paired-Samples t-tests with the proportion scores and the One-Sample t-tests with the difference scores showed that parents and children's concepts of God differed in expected ways. Consistent with previous research with 5-year-old children; children in this study were more likely than their parents to assign God mind- and body-dependent properties, on average (Shtulman, 2008). The difference between parents' and children's concept of God's mind-dependent properties was much smaller than the difference between parents' and children's concept of God's body-dependent properties.

The item-by-item correspondence analyses demonstrated that (a) parents and their children corresponded most on whether or not God can *see*, *know*, and *is alive*, and (b) corresponded least on whether or not God can *eat food*, *breathe*, and has *bones*. The

Paired-Samples t-test between the total summed correspondence scores for mind- and body-dependent properties confirmed the pattern of correspondence revealed by the item-by-item analyses. Parents and children corresponded most on whether or not God has psychological properties, with both dyad members tending to respond that God does have mind-dependent properties. They were least likely to corresponded on whether or not God has physiological properties with children responding that God does, and their parents more likely to respond that God does not.

For concepts of the natural entity, the correlational analyses demonstrated that parents and children's concepts of the mind-dependent properties of germs were not significantly related. However, parents and children's concepts of the body-dependent properties of germs were positively related to each other, though the relationship was very small. The Paired-Samples t-tests with the proportion scores, and the One-Sample t-tests with the difference scores showed that children in this study were less likely than adults to assign germs body-dependent properties, on average (i.e., consistent with Solomon & Cassimatis, 1999). The difference between parents' and children's concept of germs' mind-dependent properties was much smaller than the difference between parents' and children's concept of germs' body-dependent properties.

The item-by-item correspondence analyses demonstrated that (a) parents and their children corresponded most on whether or not germs can *know, have bones, and make plans*, and (b) corresponded least on whether or not germs *eat food, breathe, and grow old*. The Paired-Samples t-test between the total summed correspondence scores for mind- and body-dependent properties confirmed the pattern of correspondence revealed

by the item-by-item analyses. In other words, parents and children corresponded most on whether or not germs have psychological properties, with both dyad members tending to state that germs do not have mind-dependent properties. They were least likely to correspond on whether or not germs have physiological properties, with parents more likely to respond that germs do, and their children to respond that germs do not.

The difference scores examined in RO2 highlighted domain (i.e., mind- and body-dependent) level differences in concepts of God and germs between parents and children. It provided a crude overall indicator of parent-child concept differences. Even though parents and children need not agree on each specific item within the concept to have similar concepts generally, in this study (a) parents and children significantly differed in their domain general concepts for both God and germs, (b) and parents and children's concepts were generally not significantly related to each other. As a result, another more informative way to examine the relationship between parents and children's concepts, is to examine item-by-item similarities, and additionally to examine the summation of those similarities.

In order to dig deeper into the more specific nature of the similarities between parents and children's concepts, within-domain analyses were conducted. The item-by-item chi-square tests between parents and children revealed where parents and children were most similar within each entity concept. The summed total correspondence score created from the item-by-item analyses eluded to the more specific nature of the overall correspondence between parents and children. These latter analyses revealed where the



greatest differences and the greatest similarities were between parents and children's concepts, and effectively provided richer information on correspondence.

The next set of analyses presented in research objective three sought to examine predictors of parent-child conceptual correspondence using the summed item-by-item correspondence scores. The *summed item-by-item correspondence* scores captures more specific variation in correspondence, and given the significant differences between parents and children's concept proportion scores (i.e., domain differences), this more precise measure enhances the inferences that can be made about what the patterns of correspondence mean.

### **Research Objective 3 (RO3) Results**

#### **Analysis Plan**

In order to examine the above hypotheses for RO3, the following planned statistical tests were run: (1) a series of Pearson's  $r$  correlations to examine the magnitude and direction of the relationships between the variables, (2) a series of hierarchical multiple linear regression analyses to examine moderating relationships, and (3) structural equation modelling using IBM SPSS Amos software in order to test the hypothesized mediating relationships depicted in Figure 1 above. Finally, simple descriptive statistics analyzed the answers of children to questions about where they receive information from on both entity types.

#### **Predicting Correspondence for Concepts of God**

**Correlations: Concept of God's mind-dependent properties.** Parent-child correspondence for God's mind-dependent properties was significantly related to the

following parent characteristics: (a) parents' belief in God's reality,  $r = .423, p < .001$ ; (b) parents' engagement in religious activities,  $r = .325, p < .001$ ; (c) parents' affiliation with a religion (i.e., point-biserial correlation),  $r = .400, p < .001$ ; and (d) parents' analytical thinking style,  $r = -.265, p = .003$ . The correlations with the religious characteristics of the parents (i.e., parents' belief, behavior, and belonging) were positive and moderate-to-large in size. In other words, greater religiosity of the parent co-varied with greater correspondence between parent-and-child in God's mind-dependent properties. The relationship with analytical thinking style was negative and small in size; higher analytical thinking style scores co-varied with lower levels of parent-child correspondence.

Reflecting the findings with parents' religious characteristics, correspondence also was positively related to children's engagement in: (a) God-related talk,  $r = .417, p < .001$ ; and (b) God-related activities,  $r = .324, p < .001$ . These relationships were moderate-to-large and positive; greater engagement of children by parent co-varied with greater parent-child correspondence of God's mind-dependent properties. Finally, correspondence was positively related to the reported salience of the concept by parents: (a) for children to know about God,  $r = .454, p < .001$ ; and (b) for children to believe in God,  $r = .480, p < .001$ . These relationships were moderate-to-large and positive; reported salience by parent co-varied with greater parent-child correspondence of God's mind-dependent properties. Correspondence was unrelated to all child attribute variables: (a) age ( $r = .144, p = .113$ ), (b) conflict inhibition ( $r = .174, p = .064$ ), (c) executive functioning ( $r = .056, p = .539$ ), (d) working memory ( $r = .094, p = .302$ ), and

(e) theory-of-mind ( $r = .095, p = .297$ ). See Table 9 in Appendix C for the means, standard deviations (SDs), and correlations.

**Correlations: Concept of God's body-dependent properties.** Unlike parent-child correspondence for God's mind-dependent properties, correspondence for God's body-dependent properties was only significantly related to parent affiliation,  $r = -.191, p = .047$ . This point-biserial correlation revealed that correspondence was higher among parents not affiliated with a religion; however, this finding should be looked at with some additional skepticism given the low and unequal sample size between groups (i.e., affiliated,  $n = 64$ ; non-affiliated,  $n = 25$ ). Correspondence and the frequency of child engagement in activities with parents pertaining to God was not significant, but was trending,  $r = .176, p = .052$ .

None of the other variables were significantly correlated or trending with parent-child correspondence of God's body-dependent properties: (a) age ( $r = .034, p = .714$ ), (b) conflict inhibition ( $r = .032, p = .735$ ), (c) executive functioning ( $r = .112, p = .220$ ), (d) working memory ( $r = .130, p = .156$ ), (e) theory-of-mind ( $r = .033, p = .717$ ), (f) parent belief in God's reality ( $r = -.014, p = .875$ ), (g) parent's engagement in religious activities ( $r = .064, p = .483$ ), (h) parent's analytical thinking style ( $r = .114, p = .212$ ), (i) God-related talk ( $r = .074, p = .416$ ), (j) importance for children to know about God ( $r = .030, p = .743$ ), and (k) importance for children to believe in God ( $r = .004, p = .969$ ). See Table 9 in Appendix C for the means, standard deviations (SDs), and correlations.

**Confirmatory factor analysis: Salience.** It was originally hypothesized that parents' reports of the importance for their child to know about God and believe in God

(i.e., called salience in the hypothesized conceptual model) would be related to, but still independent of, parents' report of how often they: (a) talk to their child about God, and (b) engage in behaviors with their child pertaining to God (i.e., called child engagement in the hypothesized conceptual model). Correlational analyses revealed very high correlations between those four questions, with correlations ranging .719 to .877. These four questions also had a very large internal consistency (Cronbach's  $\alpha = .931$ ).

A follow-up confirmatory factor analysis (CFA) was performed using the software program SPSS Amos and revealed that that all four questions loaded onto one single latent construct, labeled "salience". The model was estimated using maximum likelihood estimation. When fitting data to a model in a CFA, a comparative fit index (CFI) greater than or equal than 0.95, a root mean square error of approximation (RMSEA) less than 0.08, and a Tucker-Lewis index (TLI) greater than or equal than 0.95 all indicate that the model fits the data acceptably well (Schreiber, Nora, Stage, Barlow, & King, 2006). Based upon responses obtained from this small sample of participants ( $n = 99$  parents, smaller than what is considered ideal for CFA), the analysis suggested that this model fit very well,  $\chi^2(1) = 0.222, p = .637$ ; TLI = 1.011; CFI = 1.000; RMSEA = .000, CI [.000, .187] (Schreiber, Nora, Stage, Barlow, & Kind, 2006). See Figure 2 for visual depiction of the CFA.

As a result of the CFA, parents' answers to the following were z-scored so they were on the same scale, and then averaged for an overall *salience* score ( $M = -.013, SD = .906$ ): God talk, God-related behaviors, salience-know, and salience-believe. What the results of this CFA may indicate is that among parents, on average, the importance they

place on the concept of God for their children, is highly reflective of, and entangled with, the frequency in which they engage in practices that socialize their children about God.

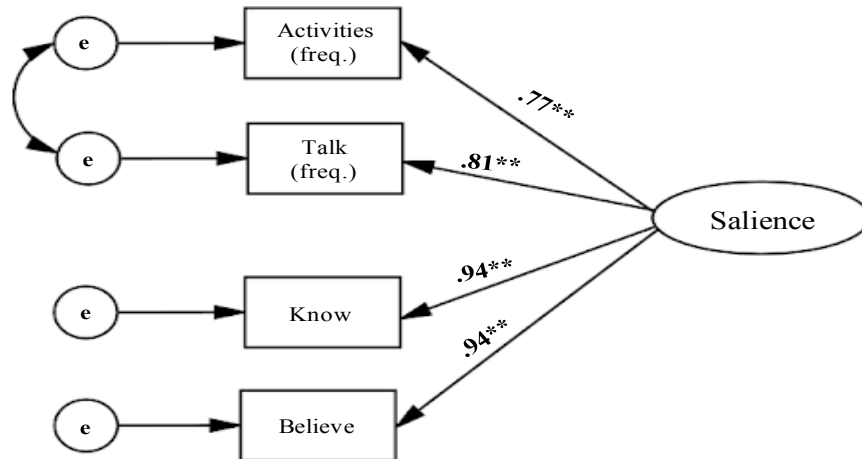


Figure 2. *Confirmatory Factor Analysis: Salience*

**Moderators.** No child attribute variables (i.e., age, executive functioning, working memory, and theory-of-mind) were related to correspondence for mind-dependent and body-dependent properties of God in the zero-order correlations described above. However, since there were a priori hypotheses stating that the child attribute characteristics would moderate the relationship between parent-reported salience and correspondence, the following interaction terms were created to test for moderation: (a) Salience by Child Age, (b) Salience by Conflict Inhibition, (c) Salience by Child EF, (d) Salience by Child Working Memory, and (e) Salience by Child Theory-of-Mind. A hierarchical linear regression model was run separately to test if each of the child attribute characteristics were moderators. Correspondence was the dependent variable, and the independent variables included: (a) salience, (b) the child attribute being tested, and (c) the salience by attribute being tested interaction term.

**Correspondence: Mind.** Parent-child correspondence of God’s mind-dependent properties was the dependent variable. None of the interaction terms were significant above and beyond parent-reported salience, indicating that none of the child attribute variables were moderating influences: (a) Salience by Child Age ( $\beta = -.097, p = .306$ ), (b) Salience by Conflict Inhibition ( $\beta = -.549, p = .211$ ), (c) Salience by Child EF ( $\beta = -.146, p = .781$ ), (d) Salience by Child Working Memory ( $\beta = -.098, p = .449$ ), and (e) Salience by Child Theory-of-mind ( $\beta = .424, p = .076$ ). See table 10 for a summary of the hierarchical linear regression models.

Table 10  
*Moderation Analyses for God Correspondence: Mind-Dependent*

	B	B SE	$\beta$	95% CI for B		Adj. $R^2$	F
				LL	UL		
<i>Base Model</i>							
Salience	0.846	0.149	0.460**	0.552	1.141	0.205	32.476**
<i>Model with Age</i>							
Salience	-0.065	0.878	-0.035	-1.804	1.674	0.205	11.487**
Age	0.119	0.121	0.081	-0.120	0.358		
Salience x Age	0.130	0.127	0.490	-0.121	0.381		
<i>Model with Conflict Inhibition</i>							
Salience	1.807	0.781	1.007*	0.259	3.355	0.240	12.896**
Conflict Inhibition (CH)	0.024	0.010	0.205*	0.004	0.044		
Salience x CH	-0.012	0.009	-0.549	-0.031	0.007		
<i>Model with Executive Functioning</i>							
Salience	0.879	0.149	0.476**	0.583	1.174	0.213	11.926**
Executive Functioning (EF)	0.243	0.219	0.138	-0.191	0.677		
Salience x EF	-0.085	0.073	-0.146	-0.230	0.059		
<i>Model with Working Memory</i>							
Salience	0.872	0.149	0.472**	0.576	1.168	0.214	11.950**
Working Memory (WM)	0.181	0.146	0.133	-0.109	0.470		
Salience x WM	-0.039	0.042	-0.098	-0.123	0.045		
<i>Model with Theory-of-mind</i>							
Salience	0.106	0.436	0.057	-0.758	0.969	0.218	12.368**
Theory-of-mind (ToM)	0.116	0.123	0.075	-0.128	0.359		
Salience x ToM	0.229	0.128	0.424†	-0.024	0.482		

† < .10. \* p < .05. \*\* p < .01.

**Correspondence: Body.** Correspondence of God’s body-dependent properties was the dependent variable. None of the interaction terms were significant, indicating that none of the child attribute variables were moderating influences: (a) Salience by Child Age ( $\beta = .912, p = .091$ ), (b) Salience by Conflict Inhibition ( $\beta = -.169, p = .741$ ), (c) Salience by Child EF ( $\beta = .138, p = .646$ ), (d) Salience by Child Working Memory ( $\beta = .147, p = .975$ ), and (e) Salience by Child Theory-of-Mind ( $\beta = .272, p = .316$ ). See table 11 for a summary of the hierarchical linear regression models.

Table 11  
Moderation Analyses for God Correspondence: Body-Dependent

	B	B SE	$\beta$	95% CI for B		Adj. R <sup>2</sup>	F
				LL	UL		
<i>Base Model</i>							
Salience	0.130	0.154	0.077	-0.175	0.435	-0.002	0.711
<i>Model with Age</i>							
Salience	-1.398	0.907	-0.827	-3.195	0.399	0.006	1.224
Age	0.037	0.125	0.027	-0.212	0.285		
Salience x Age	0.223	0.131	0.912†	-0.036	0.483		
<i>Model with Conflict Inhibition</i>							
Salience	0.367	0.878	0.212	-1.373	2.107	-0.023	0.155
Conflict Inhibition (CH)	0.005	0.011	0.041	-0.018	0.027		
Salience x CH	-0.004	0.011	-0.169	-0.025	0.018		
<i>Model with Executive Functioning</i>							
Salience	0.103	0.156	0.061	-0.205	0.412	0.000	0.987
Executive Functioning (EF)	0.005	0.229	0.003	-0.449	0.459		
Salience x EF	0.074	0.076	0.138	-0.077	0.225		
<i>Model with Working Memory</i>							
Salience	0.101	0.155	0.059	-0.206	0.408	0.008	1.322
Working Memory (WM)	0.035	0.153	0.028	-0.269	0.339		
Salience x WM	0.053	0.044	0.147	-0.035	0.141		
<i>Model with Theory-of-mind</i>							
Salience	-0.305	0.457	-0.180	-1.209	0.599	-0.010	0.607
Theory-of-mind (ToM)	0.042	0.129	0.030	-0.214	0.298		
Salience x ToM	0.135	0.134	0.272	-0.131	0.400		

† < .10. \* p < .05. \*\* p < .01.

**God's mind-dependent properties: Conceptual model.** Using SPSS Amos, the full hypothesized conceptual model visually represented in figure 1 was tested to see if it predicted correspondence for God's mind-dependent properties. The model (i.e., Model 1) fit the data ( $\chi^2(3) = 6.786, p = .079$ ; TLI = .908; CFI = .987; RMSEA = .102, CI [.000, .206]). However, the paths from the parent characteristics (i.e., religious belief, behavior, and belonging) to child belief were not significant. As a result, a pared-down model excluding those insignificant paths was tested (i.e., Model 2), and it fit the data ( $\chi^2(6) = 10.262, p = .114$ ; TLI = .948; CFI = .985; RMSEA = .076, CI [.000, .154]; see Figure 3 with standardized coefficients). The chi-square difference statistic between model 1 and model 2 was not significant ( $\chi^2(3) = 3.476, p > .10$ ); this suggests that the smaller, more parsimonious model is acceptable and fits somewhat better than model 1 (Werner & Schermelleh-Engel, 2010).

Model 2 lent support for the following. First, parent-reported salience of concept was predicted by parent religious characteristics (i.e., belief, behavior, belonging) factors. Parents' belief in God, affiliation with a religion, and frequency of engagement in religious practices accounted for 79% of the variance explained in parents reported salience ( $R^2 = .79$ ). Second, children's belief in the reality of God's existence was significantly related to parents' reported salience. Third, correspondence for God's mind-dependent properties was predicted by child's belief in God's existence and parent-reported entity salience; those two variables accounted for 25% of the variance in correspondence ( $R^2 = .25$ ). All paths in the model were significant. Overall, the relationship between parent characteristics and correspondence was mediated by parent-



reported salience (which included the engagement of children in God-related activities and discourse); and parent-reported salience was partially mediated by children’s belief in the reality of God.

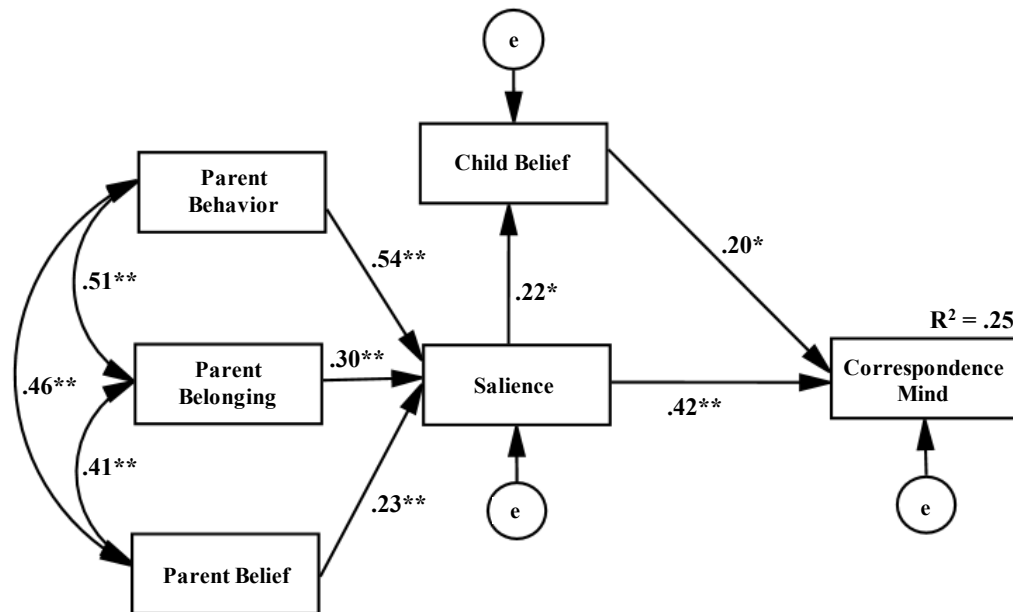


Figure 3. *Predicting Correspondence of God’s Mind-Dependent Properties*

**God’s body-dependent properties: Conceptual model.** Even though children’s belief in God’s reality status and parents’ purported salience (which includes engagement of children in God-related activities and discourse) were not significantly related to the parent-child correspondence scores for God’s body-dependent properties in the zero-order correlational analyses, the full hypothesized conceptual model visually represented in figure 1 was tested with structural equation modeling. This model did not fit the data ( $\chi^2(3) = 11.892, p = .008$ ; TLI = .760; CFI = .968; RMSEA = .156, CI [.070, .253]; see Figure 4 with standardized coefficients) and none of the paths predicting correspondence were significant. The coefficient for the path between child’s belief and correspondence

was insignificant,  $\beta = -.079, p = .395$ . As was the path between salience and correspondence,  $\beta = .094, p = .312$ .

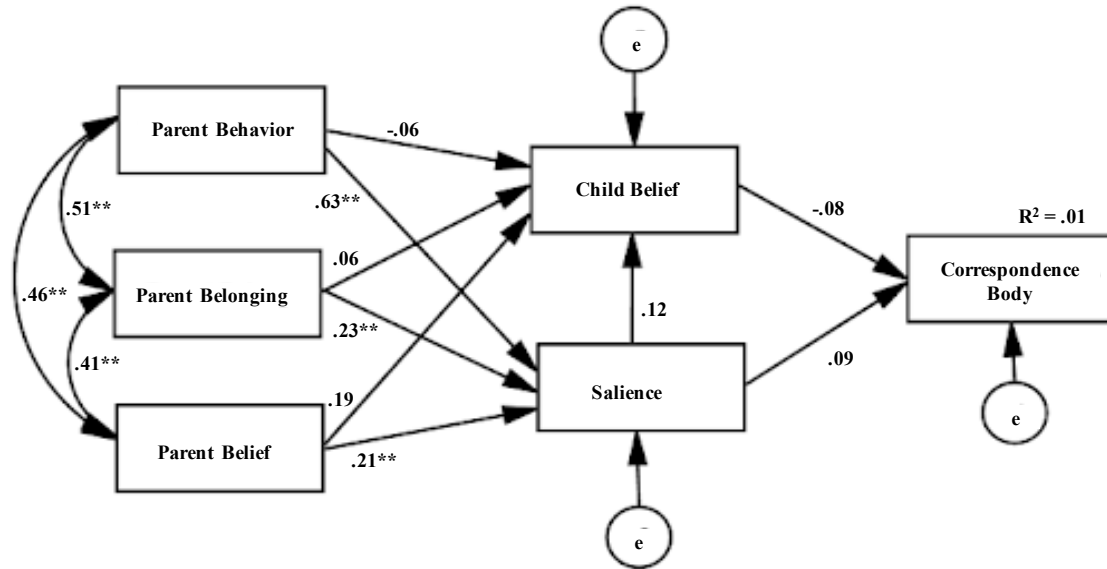


Figure 4. *Predicting Correspondence of God’s Body-Dependent Properties*

**Information sources.** Children answered a question about who they learned about God from; 28.5% of children did not give an answer (e.g., said “I don’t know”) or said, “I just knew”. The most common answer given was parent. Children said “mom” and/or “dad” 30.08% of the time. The next most common answer was “church” or the naming of another religious organization/community; 22.76% of children gave a religious organization/community answer first. See Table 12 for the list of sources named by children and the percentage of children that named it first.

Children were also asked by the researcher whether or not the parent that filled out the questionnaire and accompanied them to the study, has ever talked to them about God. 64.2% ( $n = 79$ ) of children stated that their parent talks to them about God. An

Independent-Samples t-test was run to examine whether or not there was a significant difference in how much parents reported talking to their children about God, between children that stated their parent does talk to them (i.e., group 1) and children that stated that their parent does not talk to them about God (i.e., group 2). There was a significant difference in the frequency of reported talking to their children about God between these groups,  $t(120) = -2.421, p = .017, d = .460$ . Children that said their parent talks to them about God had parents that reported talking to them about God more often ( $M = 3.65, SD = 1.387$ ) than children that said their parents did not talk to them about God ( $M = 2.98, SD = 1.581$ ).

Table 12  
*Initial Source Reported by Child for God*

	%	Examples
Parent	30.08	“My mom”
Church/ Religious Organization	22.76	“At Sandals church”
Don't Know/No Response	21.14	“I don’t know”
School/Teacher	13.82	“Ms. Smith”
Self	7.32	"I just know", "my brain"
Media	3.25	"iPad at home"
Other Family	1.63	“My cousins”

However, parents with children that stated their parents did not talk with them about God still reported talking to their children monthly on average, indicating a discrepancy between parents’ and children’s reports. Children were also asked whether or not they have talked to their friends at school, teacher(s), sibling(s), grandparent(s) and/or someone else about God. Half of the children with siblings said that they have talked to their siblings about God, almost half of children said a grandparent has talked to them about God, and about a fifth of children said their teacher at school has talked about

God before. See Table 13 for the percentage of children that stated that each potential socializing agent talks to them about God.

Table 13  
*Source of Discourse About God: Reported by Child*

	% Yes
Parent	65.85
Sibling	52.63 <sup>a</sup>
Grandparent	39.84
Friend	39.84
Other (e.g., other parent)	32.52
Teacher at School	21.14

*Note<sup>a</sup>*. Percent based on the 77% of children that have siblings

### **Predicting Correspondence for Concepts of Germs**

**Correlations: Concept of germs' mind-dependent properties.** Parent-child correspondence for germs' mind-dependent properties was not significantly related to the following parent characteristics: (a) parents' belief in the reality of germs ( $r = -.032, p = .726$ ), (b) parents' pathogen sensitivity ( $r = -.161, p = .082$ ), (c) parents' contamination sensitivity ( $r = -.069, p = .460$ ); and (d) parents' analytical thinking style ( $r = -.087, p = .345$ ). Pathogen sensitivity was not significantly related, although there was a trending relation between pathogen sensitivity and correspondence. Correspondence was not related to children's engagement in germ-related talk ( $r = -.056, p = .547$ ) or germ-related activities ( $r = -.119, p = .194$ ). Correspondence was not related to the reported salience of the concept by parents: (a) for children to know about germs ( $r = -.041, p = .657$ ), and (b) for children to believe in germs, ( $r = -.066, p = .476$ ).

Correspondence was unrelated to all child attribute variables: (a) age ( $r = .048, p = .604$ ), (b) conflict inhibition ( $r = .051, p = .594$ ), (c) executive functioning ( $r = -.022, p$

= .814), (d) working memory ( $r = -.149, p = .103$ ), and (e) theory-of-mind ( $r = .046, p = .617$ ). Correspondence was positively related to children's belief in the reality of germs,  $r = .192, p = .036$ . Greater reported belief in the reality of germs, co-varied with higher correspondence. See Table 14 in Appendix C for means, standard deviations, and correlations.

**Correlations: Concept of Germs' body-dependent properties.** Parent-child correspondence for germs' body-dependent properties was not significantly related to the following parent characteristics: (a) parents' belief in the reality of germs ( $r = -.107, p = .245$ ), and (b) parents' contamination sensitivity ( $r = .036, p = .703$ ). Correspondence was not related to parents' pathogen sensitivity, but it was trending,  $r = .181, p = .052$ . Correspondence was negatively related to parents' analytical thinking style,  $r = -.180, p = .050$ . Correspondence was negatively related to parent-reported salience for children to *know* about germs,  $r = -.188, p = .041$ , and was not related to salience for children to *believe*, the relationship was trending,  $r = -.152, p = .099$ .

Correspondence was not related to children's engagement in germ-related activities ( $r = -.138, p = .135$ ); but was related to children's engagement in germ-related talk ( $r = -.231, p = .011$ ). Correspondence was unrelated to all child attribute variables: (a) age ( $r = .093, p = .313$ ), (b) conflict inhibition ( $r = .033, p = .735$ ), (c) executive functioning ( $r = .173, p = .060$ ), (d) working memory ( $r = -.078, p = .398$ ), and (e) theory-of-mind ( $r = -.092, p = .320$ ). The relationship with executive functioning was not significant, but trending. Correspondence was not significantly related to children's belief in the reality of germs, but was trending,  $r = -.153, p = .097$ . Overall, the following

co-varied with higher correspondence of germs' body-dependent scores: less frequent talk with parents about germs, lower reported importance by parents for children to know about germs, and lower parent scores on analytical thinking style. See Table 14 in Appendix C for means, standard deviations, and correlations.

**Salience scores.** Parents' reports of the importance for their child to: (a) know about germs, and (b) believe in germs (i.e., called salience in the hypothesized conceptual model) were strongly and significantly related to each other. As a result, they were averaged for an overall *salience* score ( $M = 2.192$ ,  $SD = .654$ , Cronbach's  $\alpha = .831$ ). Unlike the salience variable for concepts of God, this salience score for concepts of germs was not related to how often parents reportedly engaged their children in germ-related activities ( $r = .003$ ,  $p = .975$ ), but it was significantly related to how often parents reportedly talk to their children about germs,  $r = .372$ ,  $p < .001$ . Though salience was positively related to germ-related talk, the small-to-moderate size of the correlation implies they are not the same construct; as a result, these variables were kept separate for the following analyses, unlike how it was treated for the analyses for correspondence of concepts of God.

**Moderators.** All child attribute variables (i.e., age, executive functioning, working memory, and theory-of-mind) were not related to correspondence for mind-dependent and body-dependent concepts of germs in the zero-order correlations described above. However, since there were a priori hypotheses stating that the child attribute characteristics would moderate the relationship between parent-reported salience and correspondence, the following interaction terms were created to test for moderation: (a)

Saliency by Child Age, (b) Saliency by Conflict Inhibition, (c) Saliency by Child EF, (d) Saliency by Child Working Memory, and (e) Saliency by Child Theory-of-Mind. A hierarchical linear regression model was run separately to test whether or not each of the child attribute characteristics were moderators. While correspondence was the dependent variable, the independent variables included: (a) saliency, (b) the child attribute being tested, and (c) the saliency by attribute being tested interaction term.

Table 15  
Moderation Analyses for Correspondence of Germs' Mind-Dependent Properties

	B	B SE	$\beta$	95% CI for B		Adjusted R <sup>2</sup>	F
				LL	UL		
<i>Base Model</i>							
Saliency	-0.199	0.188	-0.058	-0.491	0.253	-0.005	0.402
<i>Model with Age</i>							
Saliency	0.419	1.150	0.205	-1.859	2.698	-0.018	0.306
Age	0.226	0.365	0.189	-0.497	0.950		
Saliency x Age	-0.078	0.163	-0.307	-0.400	0.245		
<i>Model with Conflict Inhibition</i>							
Saliency	-0.671	1.230	-0.325	-3.110	1.767	-0.016	0.436
Conflict Inhibition (CH)	-0.006	0.034	-0.066	-0.073	0.060		
Saliency x CH	0.006	0.015	0.288	-0.023	0.035		
<i>Model with Executive Functioning</i>							
Saliency	-0.071	0.556	-0.035	-1.172	1.031	-0.022	0.150
Executive Functioning (EF)	0.012	0.463	0.008	-0.905	0.928		
Saliency x EF	-0.018	0.198	-0.038	-0.411	0.375		
<i>Model with Working Memory</i>							
Saliency	0.297	0.736	0.145	-1.161	1.754	0.004	1.144
Working Memory (WM)	0.043	0.366	0.040	-0.682	0.769		
Saliency x WM	-0.090	0.152	-0.283	-0.392	0.212		
<i>Model with Theory-of-mind</i>							
Saliency	0.396	0.579	0.194	-0.751	1.543	-0.012	0.511
Theory-of-mind (ToM)	0.435	0.417	0.351	-0.392	1.261		
Saliency x ToM	-0.164	0.175	-0.405	-0.510	0.181		

† < .10. \* p < .05. \*\* p < .01.

**Correspondence: Mind.** Correspondence of germs' mind-dependent properties was the dependent variable. None of the interaction terms were significant above and beyond parent-reported saliency, indicating that the child attribute characteristics were

not moderating influences: (a) Salience by Child Age ( $\beta = -.307, p = .634$ ), (b) Salience by Conflict Inhibition ( $\beta = .288, p = .691$ ), (c) Salience by Child EF ( $\beta = -.038, p = .928$ ), (d) Salience by Child Working Memory ( $\beta = -.283, p = .558$ ), and (e) Salience by Child Theory-of-Mind ( $\beta = -.405, p = .349$ ). See table 15 for a summary of the hierarchical linear regression models.

Table 16  
Moderation Analyses for Correspondence of Germs' Body-Dependent Properties

	B	B SE	$\beta$	95% CI for B		Adjusted R <sup>2</sup>	F	
				LL	UL			
<i>Base Model</i>							0.025	4.053*
Salience	-0.362	0.180	-0.183*	-0.718	-0.006			
<i>Model with Age</i>							0.019	1.776
Salience	0.020	1.091	0.010	-2.142	2.182			
Age	0.232	0.346	0.202	-0.454	0.918			
Salience x Age	-0.055	0.154	-0.226	-0.360	0.250			
<i>Model with Conflict Inhibition</i>							0.029	2.099
Salience	-0.099	1.134	-0.050	-2.347	2.149			
Conflict Inhibition (CH)	0.016	0.031	0.174	-0.045	0.077			
Salience x CH	-0.004	0.014	-0.228	-0.031	0.023			
<i>Model with Executive Functioning</i>							0.043	2.762*
Salience	-0.088	0.523	-0.045	-1.124	0.948			
Executive Functioning (EF)	0.474	0.433	0.352	-0.384	1.332			
Salience x EF	-0.105	0.185	-0.233	-0.472	0.262			
<i>Model with Working Memory</i>							0.028	2.131
Salience	0.481	0.704	0.243	-0.914	1.876			
Working Memory (WM)	0.334	0.349	0.320	-0.359	1.026			
Salience x WM	-0.180	0.145	-0.593	-0.468	0.107			
<i>Model with Theory-of-mind</i>							0.029	2.192†
Salience	0.268	0.560	0.136	-0.841	1.378			
Theory-of-mind (ToM)	0.349	0.402	0.294	-0.447	1.145			
Salience x ToM	-0.199	0.167	-0.511	-0.530	0.132			

† < .10. \* p < .05. \*\* p < .01.

**Correspondence: Body.** Correspondence for germs' body-dependent properties was the dependent variable. None of the interaction terms were significant above and beyond parent-reported salience, indicating that the child attribute characteristics were not moderating influences: (a) Salience by Child Age ( $\beta = -.226, p = .720$ ), (b) Salience



by Conflict Inhibition ( $\beta = -.228, p = .746$ ), (c) Salience by Child EF ( $\beta = -.233, p = .571$ ), (d) Salience by Child Working Memory ( $\beta = -.593, p = .217$ ), and (e) Salience by Child Theory-of-Mind ( $\beta = -.511, p = .235$ ). See table 16 for a summary of the hierarchical linear regression models.

**Germs' mind-dependent properties: Conceptual model.** Using SPSS Amos, the full hypothesized conceptual model visually represented in figure 1 was tested to examine if it significantly predicted correspondence for germs' mind-dependent properties. The model (i.e., Model 1) did not fit the data ( $\chi^2 (7) = 22.058, p = .002$ ; TLI =  $-.626$ ; CFI =  $.684$ ; RMSEA =  $.133$ , CI [ $.073, .197$ ]). The paths from the parent characteristics (i.e., belief in germs, pathogen, and contamination) to child belief, salience, and the two social learning opportunities (i.e., talk, activities) were not significant. As a result, a pared-down model excluding those insignificant paths was tested (i.e., Model 2), and it fit the data ( $\chi^2 (1) = 0.03, p = .862$ ; TLI =  $2.224$ ; CFI =  $1.000$ ; RMSEA =  $.000$ , CI [ $.000, .134$ ]; see Figure 5 with standardized coefficients).

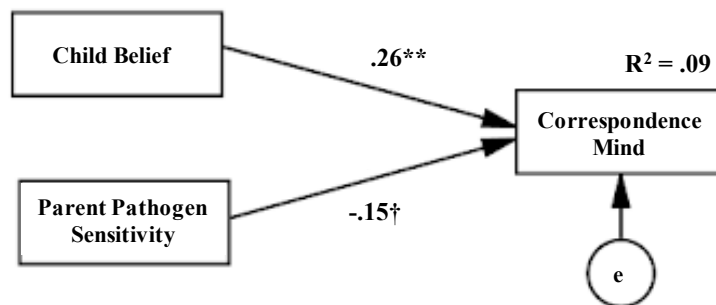


Figure 5. *Predicting Correspondence of Germs' Mind-Dependent Properties*

Model 2 lent support for children's belief in the reality of germs' existence as a significant predictor of parent-child correspondence of germs' mind-dependent

properties. The coefficient was small and positive ( $\beta = .26, p = .004$ ). The relationship between parents' pathogen sensitivity was negative and trending ( $\beta = -.15, p = .09$ ). Overall the model explained 9% of the variance in correspondence scores.

**Germs' body-dependent properties: Conceptual model.** Using SPSS Amos, the full hypothesized conceptual model visually represented in figure 1 was tested to examine if it significantly predicted correspondence for germs' body-dependent properties. The model (i.e., Model 1) did not fit the data ( $\chi^2 (7) = 24.853, p = .001$ ; TLI = -.660; CFI = .677; RMSEA = .145, CI [.086, .208]). The paths from the parent characteristics (i.e., belief in germs, pathogen, and contamination) to child belief, salience, and the two social learning opportunities (i.e., talk, activities) were not significant. As a result, a pared-down model excluding those insignificant paths was tested (i.e., Model 2), and it fit the data ( $\chi^2 (3) = 2.554, p = .466$ ; TLI = 1.031; CFI = 1.000; RMSEA = .000, CI [.000, .149]; see Figure 6 with standardized coefficients).

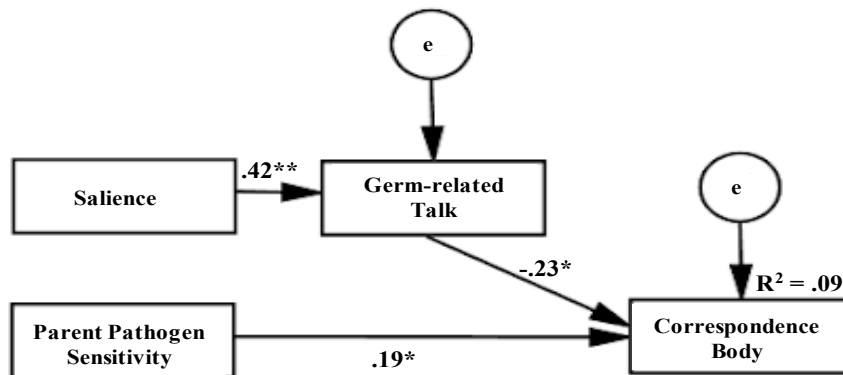


Figure 6. *Predicting Correspondence of Germs' Body-Dependent Properties*

Model 2 lent support for the following: (a) germ-related talk (i.e., child engagement) mediated the relationship between parent reported salience and the

correspondence of body-dependent properties, and (b) one of the parent characteristics, parent pathogen sensitivity, was directly related to, and predictive of, correspondence. Overall the model explained 9% of the variance in correspondence scores. All paths in the model were significant. Overall, the hypothesized model of conceptual correspondence (i.e., visually represented in Figure 1) partially predicted conceptual correspondence of germs' body-dependent properties.

**Information Sources.** Children answered a question about who they learned about germs from; 22.77% of children did not give an answer (e.g., said “I don’t know”) or said, “I just knew”. The most common answer given was parent. Children said “mom” and/or “dad” 30.89% of the time. The next most common answer was “school or teacher”; 27.74% of children gave that answer first. See Table 17 for the list of sources named by children and the percentage of children that named that source first.

Table 17  
*Initial Source Reported by Child for Germs*

	%	Examples
Parent	30.89	“My mom”
School/Teacher	27.74	“Ms. Smith”
Don't Know/No Response	17.89	“I don’t know”
Media	15.45	"iPad at home"
Self	4.88	"I just know", "my brain"
Other Family	2.44	“My cousins”
Church/ Religious Organization	0.81	“At Sandals church”

Children were also asked by the researcher whether or not the parent that filled out the questionnaire and accompanied them to the study, has ever talked to them about germs. 53.66% of children stated that their parent talks to them about germs. An

Independent-Samples t-test was run to examine whether or not there was a significant difference in how much parents reported talking to their children about germs, between children that stated their parent does talk to them (i.e., group 1) and children that stated that their parent does not talk to them about germs (i.e., group 2). There was not a significant difference in the frequency of reported talking to their children about germs between these groups,  $t(120) = -1.511, p = .135$ . Children that said their parent talks to them about Germs had parents that reported talking to them about germs as often ( $M = 3.677, SD = .988$ ) as children that said their parents did not talk to them about germs ( $M = 3.361, SD = 1.317$ ). These findings indicate that there is a discrepancy between parents' and children's report. In other words, some children say they do not remember their parents talking to them about germs; but their parents report talking to them about germs.

Table 18  
*Source of Discourse About Germs: Reported by Child*

	% Yes
Parent	53.66
Sibling	44.21 <sup>a</sup>
Teacher at School	41.46
Friend	32.52
Other (e.g., other parent)	27.64
Grandparent	26.83

*Note<sup>a</sup>*. Percent based on the 77% of children that have siblings

Children were also asked whether or not they have talked to their friends at school, teacher, sibling(s), grandparent(s) and/or someone else about germs. Less than half of children with siblings said that they have talked to them about germs, only a quarter of children said a grandparent has talked to them about germs, but almost 42% of children said their teacher at school has talked about germs before. See Table 18 above

for the percentage of children that stated that each potential socializing agent talks to them about germs.

### **Difference Score and Child Attributes**

The child attribute characteristics of age, conflict inhibition, executive function, working memory, and theory-of-mind were unrelated to the summed item-to-item correspondence scores for concepts God and germs. As a result, they did not moderate the relationships between (a) correspondence and salience, and (b) correspondence and child engagement in social learning opportunities (as explained in the analyses for God and germs above). The correspondence measure used indicates *within*-subdomain (i.e., mind-dependent and body-dependent) similarity and picks up on the degree to which children and their parents answered the same way for each property asked about. This measure is more precise than a measure that picks up on the differences between parents and children's domain level concepts. However, the difference score created in research objective 2 (i.e., that subtracted a parent's concept proportion score from their children's concept proportion score) picks up on general reasoning about whether or not God and germs have psychological or physiological properties. As a result, post-hoc exploratory analyses examined whether or not the child attributes were related to the differences in the general reasoning about the concepts (i.e., difference score) between parents and children, as opposed to the within-domain reasoning explored previously (i.e., correspondence score). The difference scores for the concepts of God were unrelated to all the child attribute characteristics (see Table 19). The difference scores for the concepts of germs were unrelated to the child attributes with the following exception,

Germ's body-dependent concept had a small negative relationship to child age,  $r = -.186$ ,  $p = .041$ . In other words, higher age co-varied with decreased differences between parents and children's concepts (see Table 19). Other than that, these analyses are not dissimilar from what the correspondence analyses revealed in the earlier analyses.

Table 19  
*Child Attributes and Parent-Child Concept Difference Scores*

	1	2	3	4	5	6	7	8	9
1. Diff: God's Body	–								
2. Diff: God's Mind	.371**	–							
3. Diff: Germ's Body	.231*	.106	–						
4. Diff: Germ's Mind	.030	.029	.525**	–					
5. Child Age	-.031	-.082	-.186*	-.075	–				
6. Conflict Inhibition	-.015	.067	-.044	-.006	.557**	–			
7. Executive Function	.050	-.006	-.050	-.071	.473**	.232*	–		
8. Memory	.043	-.028	.065	-.064	.293**	.234*	.029	–	
9. Theory of Mind	.058	.014	.056	.024	.624**	.518**	.303**	.398**	–

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

### RO3 Summary

**Correspondence of God concepts.** There were four hypotheses related to what would predict parent-child correspondence concerning God-related concepts. First, it was hypothesized that parent characteristics would predict how important parents would consider the entity to be for their child to know about and believe in—this was consistent with what was found. The parent religious characteristics of belief, behavior, and belonging significantly predicted parent-reported salience of the God concept, those factors explained 79% of the variance in salience.

Next, it was hypothesized that parent-reported salience would be related to the frequency with which parents engage their children in activities and discourse related to God (i.e., social learning opportunities for God that parents create). Correlational

analyses and a confirmatory factor analysis revealed that for parents, engagement of children and reported salience of God were highly correlated, thus they were made into a single index under the umbrella of salience. How parents responded to the importance of the concept was indistinguishable from how often they engage their children in socializing behaviors related to God. In other words, parent characteristics significantly predicted reported salience and engagement of their children in activities and/or discourse. Next, it was also hypothesized that attributes of the child (e.g., theory-of-mind ability, age) would moderate the relationship between child engagement/entity salience and entity correspondence; this was not the case for either mind-dependent or body-dependent concepts of God. Child attributes were unrelated to correspondence.

Finally, as was hypothesized, the relationship between characteristics of the parent and correspondence of God's mind-dependent properties was mediated by parent-reported salience; and parent-reported salience was partially mediated by children's belief in the reality of God's existence. This was not the case for God's body-dependent properties, however. Characteristics of the parent and children's belief in the reality of God were not related to parent-child correspondence of God's body-dependent properties. Parent-child correspondence was higher for mind-dependent properties, but correspondence for God's body-dependent properties was still significantly above zero. Almost a third of children stated that their parent is how they learned about God, and almost 2/3 thirds of children said they recalled their parent talking to them about God. Parents were the most often cited as agents of children's learning about God.

**Correspondence of germ concepts.** There were four hypotheses related to what

would predict parent-child correspondence concerning germ-related concepts. First, it was hypothesized that parent characteristics would predict how important parents would consider the entity to be for their child to know about and believe in—this is not what the results suggested. The following characteristics of the parent were not significantly related to parent reported salience: parents’ belief in the existence of germs, parents’ pathogen sensitivity, and parents’ contamination sensitivity. Additionally, only one parent characteristic was significantly related to one of the correspondence scores. Parent pathogen sensitivity was significantly related to correspondence of body-dependent properties of germs, though the relationship was small.

Next, it was hypothesized that parent-reported salience would be related to the frequency with which parents engage their children in activities, and discourse related to germs (i.e., social learning opportunities for germs that parents create). Correlational analyses revealed that reported salience was positively and moderately related to engagement of their children in discourse about germs; but not related to the frequency of parents’ engagement of their children in activities or practices related to germs. Because germ-related talk was only related to correspondence of germs’ body-dependent properties, salience and germ-related talk were only added to the structural equation model that examined predictors for correspondence of body-dependent properties.

Next, it was also hypothesized that attributes of the child (e.g., theory-of-mind ability, age) would moderate the relationship between child engagement and salience, and entity correspondence; this was not the case for either mind-dependent or body-dependent concepts of germs. Child attributes were unrelated to correspondence.



Finally, it was hypothesized that the relationship between characteristics of the parent and correspondence of germs' mind- and body-dependent properties would be mediated by parent reported salience and child engagement in germ-related activities and discourse. For correspondence of mind-dependent properties of germs, this was not the case. For correspondence of body-dependent properties of germs, child engagement in discourse about germs mediated the relationship between parents reported salience and correspondence. Parent-child correspondence was higher for mind-dependent properties, but correspondence for germs' body-dependent properties was still significantly above zero. Almost one third of children stated that their parent is how they learned about germs, and a little more than half of children said they recalled their parent talking to them about germs. Even though parents were the most often cited as agents of children's learning about germs, children also frequently cited school and teachers as sources of information.

Overall, the hypothesized conceptual model explained more variance in parent-child correspondence of God's mind-dependent properties, as compared with the other three correspondence scores examined.

## Chapter 4: Discussion

The present study was guided by three research objectives. The first was to examine the extent to which children and parents conceptualize a natural-scientific and a supernatural-religious entity as having body- and mind-dependent properties. God (supernatural-religious) and germs (natural-scientific) were the two abstract entity concepts chosen because both have been used in prior research to examine the development of children's folk biology, fantasy-reality distinctions, and anthropomorphic reasoning (e.g., Guerrero, Enesco, & Harris, 2010; Harris et al., 2006; Shtulman, 2008; Shtulman & Lindeman, 2015; Solomon & Cassimatis, 1999). Using concepts examined in previous scholarship makes it possible to compare findings across time and samples of children and adults. An important commonality between the concepts of God and germs is that individuals must learn about them through social learning processes—this also makes them suitable targets for a study on the influence of parents. The second objective of this study was to examine the extent to which children's concepts of God and germs correspond with (i.e., are similar to) their parents' concepts; and the third was to examine hypothesized endogenous (e.g., child's theory-of-mind) and exogenous (e.g., parent beliefs) factors that may predict parent-child correspondence of concepts of God and germs.

This study was specifically interested in examining the influence of parent context (i.e., characteristics of the parent and social learning opportunities created by the parent) on conceptual correspondence of abstract concepts. Concepts of God and germs were additionally chosen because the settings in which children learn about them likely differ,

and this study could examine the differential impact of parents on two abstract concepts with different socializing influences. Information sharing about concepts of God are restricted by federal regulations in some forums (e.g., public school, public health establishments), and absent from other public forums because of a capitalist market orientation (i.e., businesses want to appeal to the broadest possible audience). As a result, family likely serves as the primary context in which children learn about God. Children's exposure to information about concepts of germs on the other hand, are likely more widely distributed across socialization contexts (e.g., medical, school, church, family). It is possible that a more controversial scientific concept would be limited from public forums in ways similar to religious concepts, but this study examined a relatively apolitical scientific concept.

The results of this study contribute to the scholarship on concept development in three ways. First, both children's and parent's concepts of a supernatural-religious entity and natural-scientific entity were separately measured. This replicated previous research on how children and adults conceptualize God and germs (e.g., the patterns of findings presented in: Shtulman, 2008; Solomon & Cassimatis, 1999). Children conceptualized God as a living entity with psychological and physiological properties (i.e., overall conception God as more humanlike); and parents conceptualized God as a living entity with psychological, but not physiological properties (i.e., as a bodiless agent). Children did not conceptualize germs as a living entity with psychological or physiological properties; and parents conceptualized germs as a living entity with physiological, but not psychological properties.

Second, the degree to which children's concepts were related to, and differed from their parent's concepts was described. Delineating how parents and children's concepts differed generally and by specific property item adds to an understudied area of concept development, that of parent-child correspondence during the early-to-middle childhood years. Overall, parents and children's concepts were most similar for the psychological properties of germs, and least similar for the physiological properties of God.

Third, hypothesized predictors (e.g., parent context and child characteristics) of parent-child correspondence of concepts of God and germs, and their two conceptual sub-domains, mind and body, were examined. The examination of predictors of correspondence was particularly informative about the roles of parent's beliefs and the frequency in which they engage their children in social learning opportunities related to the entity. More specifically, these factors showed a significant relationship to the correspondence of the properties parents were most likely to conceptualize the entities as having. In other words, how important parents thought the entities were, and how often they engaged their children in behaviors related to the entities, were most significantly related to the correspondence of the physiological properties of germs and the psychological properties of God. In contrast, parents did not generally conceptualize God as having physiological properties or germs as having psychological properties; and parent-child correspondence for those two concepts was generally unrelated to: (a) parent reported salience of the entity, and (b) behavioral engagement of children in activities and talk pertaining to the entity. Additionally, this study measured where children believed

they receive information about these entities, which provided context for the explanatory power of the predictors of correspondence examined. For example, children were twice as likely to say that a teacher at school had talked to them about germs, then they were to say a teacher has talked to them about God.

Participants included 123 parent-child dyads with children between 5-and-8.9-years of age. Parents' and children's concepts of the mind- and body-dependent properties of God and germs were assessed with ten questions, five representing psychological functions (i.e., to know, want, see, smell, and make plans) and five representing physiological functions (e.g., grow old, eat food, breathe, have bones, lives). Assessing concepts in this way has been used in previous studies with adults and children (e.g., Shtulman & Lindeman, 2016; Solomon & Cassimatis, 1999). The psychological and physiological properties measured in this study do not represent an exhaustive list of the properties of God or of germs, but these properties do tap into the conceptual reasoning about God and germs and enable discernment of factors that may be important to parent-child correspondence in that reasoning.

## **Concepts of God and Germs**

### **Psychological and Physiological Properties**

**Parents.** The findings among parents on concepts of God were consistent with prior research among adults where monotheism is the dominant religious doctrine (e.g., Shtulman, 2008; Shtulman & Lindeman, 2016). There was a very large significant difference between how parents conceptualized God's mind- and body-dependent properties. Parents on average stated that God has mind-dependent properties, granting

God more than half of the psychological properties asked about. Parents stated on average that God can know, want, see, and make plans. Although parents did not consistently state whether or not God can smell, the percentage of parents that reported in the affirmative (i.e., 47.5% said yes) in this study was almost 20% higher than in the original study 1 (i.e., 28.5%) by Shtulman and Lindeman (2015). The differing characteristics of the two samples may account for the greater attribution of properties among the parents in this study. For example, Shtulman and Lindeman's (2015) sample were younger (i.e., 27.7 versus 34.55 years), from a much less religious country overall (i.e., Finland; Pew Forum, 2018), and had a lower percentage of female (73.24 versus 88.6%) participants. Previous research suggests that younger individuals, females, and more religious adults grant God more psychological properties (e.g., Saide & Richert, 2017; Shtulman, 2018; Shtulman and Lindeman, 2015).

Parents granted on average a little more than one body-dependent property to God. They stated more often than not that God does not grow old, eat food, have bones, or breathe. The one property granted most often was "alive"; 57.6% of parents said that God is alive. Even though more parents stated that God is "alive" relative to the other properties asked about, parents were still not significantly likely to say "yes" or "no", God is alive. Concepts of God, like other supernatural entities, are thought to be rooted in concepts of "person" but with features that are counterintuitive (e.g., omniscience; Boyer, 2003). However, these findings suggest that parents, like other adults in the United States (e.g., in Shtulman & Lindeman, 2015), reason about God as a bodiless agent; as having a mind but not necessarily a body to house that mind. Parents' explicit

concepts of God are modified from their intuitive concept of human by cultural narratives. For example, while the initial and implicit reasoning about a novel entity such as God is anthropomorphic (e.g., Heiphetz, Lane, Waytz, & Young, 2016), religious monotheistic narratives do not imply God has the limitations of a physical form and adults in cultures where Abrahamic religions are dominant tend to conceptualize God without physiological functions. In cultures where deities are represented more anthropomorphically (i.e., Hinduism), adults are more likely to conceptualize God as having physiological properties (Shtulman & Lindeman, 2015).

In contrast to God, parents granted germs fewer mind-dependent and more body-dependent properties. Germs were conceptualized on average as a living entity (i.e., 96% stated germs are alive), but not as having mental states—this is consistent with the prior research on adults’ attribution of properties to germs (Solomon & Cassimatis, 1999). There was a very large difference between how parents conceptualized germs’ mind- and body-dependent properties. Parents on average stated that germs do not have mind-dependent properties, granting them on average less than one property. They stated that germs cannot know, see, smell or make plans. Parents were not more or less likely to state that germs can or cannot “want” something. Parents granted germs on average more than two body-dependent properties but were not more or less likely to state that germs can or cannot grow old, eat food, and breathe.

Overall, parents conceptualized God and germs in ways consistent with adults in prior research (Solomon & Cassimatis, 1999; Shtulman & Lindeman, 2015). They conceptualized God as having psychological properties but did not consistently

conceptualize God as a living organism with physiological properties. Some parents did report that God has physiological properties (e.g., 15% said God has bones) but parents were more likely not to. On the other hand, parents conceptualized germs as living, were more likely to grant them physiological properties, but did not grant them psychological ones. In other words, the findings here, in conjunction with other research (e.g., Jones & Rua, 2006), suggests that parents conceptualized God as a conscious agent, and germs as unconscious biological agents. It is important to note that while germs are non-conscious agents in a scientific sense (e.g., Persat et al., 2015), they are not always conceptualized as agents (e.g., among children).

**Children.** Even though children stated on average that God has both mind- and body-dependent properties, they granted God significantly more mind-dependent properties. Children granted God more than three body-dependent properties on average by stating that God can eat food, breathe, has bones, and is alive. Children granted God more than four mind-dependent properties on average by stating that they can know, want, see, smell, and make plans. The only property children appeared less certain about was whether or not God “can grow old”. Children were not more or less likely to state “yes” or “no” to that question.

Children’s report of God as having mind- and body-dependent properties is consistent with prior research among non-Muslim children (e.g., Shtulman, 2008; Saide & Richert, 2017). Previous research has shown that as children get older they attribute fewer humanlike limitations (e.g., to forget, to get bored) to God (Richert, Shaman, Saide, & Lesage, 2016), but in this study the properties asked about were not suggestive



of having limitations per se. For example, in Richert and colleagues' (2016) study, they phrased a question as, "does God *need* to eat food." By using the word "need," it implies that the action is necessary for God (i.e., God is limited by needing to do it). But in this study it was phrased as "*can* God eat food." The word, "can" implies an ability as opposed to a necessity or obligation. As a result of this subtle difference, the finding that children and adults readily conceptualized God as having a humanlike mind, (and children as God having physiological functions) was expected and consistent with prior findings that tapped into properties that do not imply God is limited (see Heiphetz, Lane, Waytz, & Young, 2016).

Previous research shows that distinguishing God from humans, at least in terms of psychological properties, requires socio-cognitive understanding and intentional conscious reasoning on the part of the child (Heiphetz, Lane, Waytz, & Young, 2016); in other words, anthropomorphic reasoning about God is relatively unconsciously done, it is intuitive. Notably however, reasoning about God is not immutable to sociocultural contexts or person-level characteristics—religiosity, age, gender, and culture among adults has been linked to individual variation in anthropomorphic reasoning about God. For example, Hindu adults assign God more physiological properties than predominately Christian adults (Shtulman & Lindeman, 2015); while Muslim adults assign God fewer physical properties than do Christian adults (Saide & Richert, 2017).

While there were not significant differences in concepts between male and female children, older children assigned God about one more mind-dependent property than younger children did. The difference between younger and older children in their

concept of God's mind-dependent properties was consistent with what was hypothesized. It was hypothesized that both age groups would generally assign God mind-dependent properties and this was the case. However, it was also hypothesized that older children would grant God more mind-dependent properties because of their greater socio-cognitive understanding (i.e., theory-of-mind) and greater exposure over time to information about God. Common mythology and testimony shared with children about deities often incorporate language implying they have psychological functions such as emotions, thoughts, intentions, and desires (Heiphetz, Lane, Waytz, & Young, 2016). Additionally, children are being raised in a culture that frequently depicts God in a human form (e.g., nativity scenes during Christmas time, film and media). Taken together, these findings suggest that children in this study reasoned about God as having the same kinds of properties as humans overall. Children's answers are supportive of the anthropomorphism hypothesis, that children anchor their concept of God in their concept of person, in other words, as an agent with both mental states and physiological functions. This is in contrast to the preparedness hypothesis that suggests that children need not conceptualize God as a human before conceptualizing God as a special entity (e.g., having a mind but no body or as having special properties such as omniscience; Barrett, Richert, & Dreisenga, 2001).

In contrast to how children responded to questions about God, but consistent with prior research (e.g., Solomon & Cassimatis, 1999), children granted germs few body- and mind-dependent properties. Children granted germs the same number of body- and mind-dependent properties, just a little over one on average for each sub-domain.

Children stated on average that germs cannot grow old, eat food, breathe, know, want, see, smell, make plans, and do not have bones. The only property children seemed to be uncertain about was whether or not germs “are alive.” Children were not more or less likely to state “yes” or “no,” germs are alive. This finding replicates previous studies that found that young children do not consistently treat germs as living organisms (see Shtulman, 2017 for review). Children in this study did not generally reason about germs as living agentic entities with mind- or body- dependent properties, and several things may account for their conceptualization.

First, children in this age group (5 to 8.9 years) still have a limited folk biology and understanding of biological kinds (Carey, 1985); consequently, children in this study did not report a consistent understanding that germs are living. Second, children tend to associate germs with hygiene and illness, as something “bad” and as interfering with health (Byrne, Grace, & Hanley, 2009; Ergazaki, Saltapida, & Zogza, 2010; Jones & Rua, 2006). These associations are likely consistent with the messages children receive about the causal role of germs (i.e., in sickness) in everyday life, and about how you should react to the presence of germs (e.g., kill them). These associations may lead children to reason about germs in ways contrasting with human-like entities.

In further support of this possibility, previous research has shown that the more individuals view entities as having agency (e.g., self-control, morality), the more they are viewed as being able to experience mind-dependent properties (e.g., hunger, joy, pain) (Gray, Gray, & Wegner, 2007). To say this another way, the more an entity is humanized, the more it is also considered worthy of moral regard, and vice versa (Waytz,

Epley, & Cacioppo, 2010). Germs are not generally understood by, or treated by adults (and other socializing agents children interact with) as worthy of moral regard, slogans (e.g., “kills 99.9% of germs on contact”) prominently displayed on cleaning products and hand sanitizer emphasize this point. The lack of moral regard shown towards germs may also account for why children in the study assigned germs so few psychological properties characteristic of human agents. However, God is often associated with positive feelings and outcomes (i.e., the halo effect vs. horn effect for germs). Children were more likely to say that God is alive, and more likely in general to attribute God psychological and physiological functions. While reasoning about God leverages “good therefore like me”, germs do not (i.e., employment of self-enhancement biases, people do not want to be associated with a germ).

**Open-ended responses.** Overall, parents and children did not spontaneously describe God or germs as having body- and mind-dependent properties in the open-response questions. This is largely inconsistent with how they responded to the forced-response (i.e., close-ended) questions on God, but not necessarily the pattern of responses for germs. Parents’ had conceptualized God as having mind-dependent properties, and children conceptualized God as having both mind- and body- properties in the force-choice questions.

The discrepancy between the open-ended and close-ended patterns of reasoning about God could be due to the vagueness of the question itself and/or the vagueness of the participants’ responses. First, it is possible that this discrepancy may be a result of the question itself being phrased too vaguely (i.e., a methodological artifact). Parents and

children may not have had a clear understanding of what aspects of their thinking about God (or germs) they should share on the survey (for parents) or with the interviewer (for children). Overall, parents often wrote general information about God and germs. For example, one parent just wrote, “God guides me in life” and another wrote, “germs are organisms.” Some children simply listed all the things the entity like. For example, one child said that “God likes good people” and another child said that “germs like to make you sick.” As a result, the discrepancy between open-ended and close-ended response could also have been attributable to the vagueness of the narratives parents and children provided about God and germs, making it difficult to code for properties. The narratives on God and germs were at times simply not clear enough to discern whether a mind and/or body was being implied (e.g., God is to understand existence, germs are good and bad, germs are worse for elderly people). For example, if a parent stated, “God is a spirit,” it is still unclear whether they conceptualize a spirit as having psychological or physiological functions. Examples of properties that were assigned to God include: has a heart, listens, dances, forgives, protects, and is male. Examples of properties that were assigned to germs include: can jump, has a shape, and can grow in size.

### **Existence Judgments**

In addition to reasoning about the psychological and physiological properties of God and germs, parents and children reported their judgments about their reality status. Both parents and children, on average, conceptualized God and germs as real and existing. The percentage of parents that reportedly believe in God’s existence in this study was somewhat lower than nationally representative samples and polls of California

adults. Whereas 72.3% of parents believe in God's existence in the current study, other polls place that number between 79-and-89% (e.g., Gallup, 2016). However, parents and children did not significantly differ from each other in their existence judgments for God; while 72.3% of parents reported that God exists, 80.5% of children reported that God is real.

Parents were significantly more likely than their children to state that germs are real; while 100% of parents reported that germs exist, 88% of children reported that germs are real. The existence judgments made by children were consistent overall with children in previous research (e.g., Guerrero, Enesco, & Harris, 2010; Harris et al., 2006). This replicates previous work and demonstrates that even though God and germs are not directly observable by children (without cultural artifacts or tools in the case of germs), the endorsement of them by other people facilitates children's conceptualization of them as real. In other words, these entities are considered real by most adults in the society of which these children are being raised, and during these early-to-middle childhood years, children appear to have internalized that information (Schaffer, 2006; Vygotsky, 1978).

Existence judgments also importantly related to parent-child correspondence scores. Children's and parents' judgments about the existence of God were positively related to parent-child correspondence of God's mind-dependent properties, greater reported belief in the existence of God co-varied with greater correspondence between parent and child in whether or not God has psychological properties. Children's existence judgments about Germs was positively related to parent-child correspondence of germs' mind-dependent properties, greater reported belief in the existence of germs

co-varied with greater correspondence between parent-and-child in whether or not germs have psychological properties. This suggests that children may be more likely to attend to and/or remember information about entities like God and germs when they believe they are real. Although, this is likely the case for children that are better able to distinguish between what is real and what is not.

### **Parent-Child Correspondence**

Parents and children's concepts of God were generally not significantly related to each other. This was somewhat unexpected given previous research with younger children that showed a small positive relationship (e.g., Richert et al., 2016; Saide & Richert, 2017). However, very little research has explored the relationship between parents and children concepts, and in previous findings of this sort, body- and mind-dependent properties were collapsed as one overall measure. Or, in the case of Shtulman (2008), parents and children's concepts were disaggregated into three domains (biological, psychological, physical), were compared, but not checked for relatedness and the sample size was much smaller than this study (e.g., Shtulman, 2008).

In this study, compared to their children, parents assigned God significantly fewer mind- and body-dependent properties. The difference was small for mind-dependent properties, only 0.282 standard deviations. The difference was much larger for body-dependent properties, over one standard deviation difference between children and their parents. Children were more likely than their parents to grant God all five of the body-dependent properties asked about. As discussed earlier (i.e., beginning on page 118), children appeared to be anchoring their reasoning about God in their concept of human.

Parents on the other hand, appeared to have adjusted their anthropomorphic reasoning and conceptualized God as a bodiless conscious agent.

Parents and children's concepts of germs were also generally unrelated to each other. There was a small significant positive relationship between parents' and children's concept of germs' body-dependent properties; but parents and children's concepts in this sub-domain differed by more than one standard deviation. Parents assigned germs more body-dependent properties than their children did. This difference may have been partly driven by the question on whether or not germs are alive; 96% of parents said that germs are alive, but only 58.5% of children said that germs are alive. Also, while 58% of parents said that germs can grow old and 57% said they can eat food; only 21% of children said yes to those two property questions about germs. These differences in reasoning about the physiological properties of germs is likely attributable to children's immature understanding of the traits of living organisms, relative to their parents. In other words, children appear less knowledgeable about germs being agents and about there being both good and bad kinds of germs (Byrne, Grace, & Hanley, 2009; Ergazaki, Saltapida, & Zogza, 2010; Jones & Rua, 2006). Parents and children also significantly differed on their mind-dependent concept of germs; parents assigned fewer properties than their children did but this difference was small, 0.221 standard deviations. These findings along with the examination of predictors of correspondence will be discussed in greater detail below. First a discussion of children's general reasoning about God and germs is warranted.



**Children’s reasoning.** Previous research highlights that children will readily anthropomorphize things they believe to be agents; and not anthropomorphize things they do not consider agents (Dacey, 2017; Guthrie, 1993). Notably however, children and adults may confuse agents for non-agents (e.g., plants); and non-agents for agents (e.g., the sun), in what scholars have called an “ontological confusion” (Lindeman, Svedholm-Häkkinen, & Lipsanen, 2015). Barring this confusion, if something has been presented as an agent to a child, but the child has limited to no experience with that entity, they will reason from (i.e., make inductive inferences from) their understanding of “human,” rather than based on their direct observable experience with that entity—because they simply do not have any (Rottman & Keleman, 2012; Geerds, Van de Walle, & LoBue, 2015). The anthropomorphism hypothesis derives from the work Piaget (1969). Those in the Piagetian tradition have presupposed that children reason about God and other agents anthropomorphically until they reach middle childhood (Barrett & Burdett, 2011). In other words, a universal anthropomorphic bias seems to underlie children’s reasoning about novel nonhuman agents (Dacey, 2017; Guthrie, 1993).

With experience however, children are better able to anchor (in human) and adjust their reasoning, reflecting their parents reasoning. It might be the case that rather than anchoring in their concept of human, children are reasoning egocentrically and adjusting from their conception of themselves. Children are themselves human, and so even an egocentric base from which they reason, would make for a heuristic that is inherently anthropomorphic. In other words, children may use themselves as an anchor for understanding other agents (a) prior to the cognitive skills (i.e. theory of mind) necessary

to distinguish between themselves and others, and (b) in the absence of the cultural scripts that would provide information on those agents, like that of God. Unfortunately, this study cannot tease apart whether their anthropocentric reasoning derives from the child's concept of themselves or from their general concept of human.

Parents appear to suppress parts of their anthropomorphic reasoning in favor of matching their concepts with cultural narratives, as they did in this study by reporting on average that God has mental properties but not physiological ones. Experience and cognitive control allows for the suppression of intuitive reasoning, in favor of scientifically correct and/or culturally informed but counterintuitive narratives (Shtulman & Harrington, 2015). In further support of this, research shows that children with experience with nonhuman entities like household pets are able to apply their varied experience in making attributions to those nonhuman entities (Eddy, Gallup, & Povinelli, 1993; Medin, Waxman, & Woodring, 2010). In one study that examined the impact of daily exposure to pets on children's biological reasoning, Geerdts and colleagues (2015) found that while children without pets were no more likely to attribute psychological properties to animals than children with pets; children without pets were less likely than their counterparts with pets to attribute non-human animals with biological properties. As they described it, children with pets showed less "anthropocentric patterns of extension of novel biological information" (Geerdts, Van de Walle, & LoBue, 2015, p. 132). So in other words, "anthropomorphic reasoning" can be impacted by exposure to different contexts (Medin, Waxman, & Woodring, 2010).

What makes God and germs an interesting target of study is that children cannot have direct observable experience of God, and during the early-to-middle childhood years, likely have not had much direct experience with germs. What children have had however, is indirect secondhand information about God and germs from people and things in their social environment. Indeed, in this study, children were asked who they learned about God and germs from and the most common answer was parent, around 30% of children cited their parent (or parents) as where they learned about God and germs from. The second most common answer for germs was school/a teacher (28%) and for God it was church/religion (23%).

Overall an examination of the differences between parents and children's reasoning suggests that children anchor their reasoning about agents (and living things) in their concept of human (i.e., anthropomorphic reasoning), more so relative to their parents. Children in this study did not treat germs as humans and therefore did not assign or conceptualize them as having biological or psychological traits (even when in principle they should have been; e.g., as alive); God on the other hand, was treated as a human and assigned those properties. What accounts for differences in children's treatment of germs relative to God, and relative to their parents' concepts is likely: (a) an immature folk biology, (b) association of germs with negative affect (i.e., disgust and doing of bad things; Byrne, Grace, & Hanley, 2009), and (c) limited experience and enculturation.

Questions remain as to whether or not children's experience with behaviors related to the concepts, their parents' beliefs, and/or other attributes of the child facilitate them in reasoning more like their parents do (i.e., less human-centrally)—as previous

research on nonhuman animals has suggested (e.g., Eddy, Gallup, & Povinelli, 1993; Geerds, Van de Walle, & LoBue, 2015; Shtulman, 2018). This is where the third research objective of this study came into play. Parents concepts of God and germs significantly differed from their young children's concepts, what follows is a discussion on what factors predicted variation in parent-child correspondence.

### **Predicting Correspondence**

One of the central objectives of this study was to test factors thought to increase parent-child correspondence. The difference score examined in research objective two revealed subdomain level differences in concepts of God and germs between parents and children, it provided a rough overall indicator of parent-child concept differences. Even though parents and children need not agree on each specific item within each concept to have similar concepts overall; in this study parents and children significantly differed in their overall concepts. The summed total correspondence score created from the item-by-item analyses was used instead of the difference score to predict (i.e., in the structural equation analyses) similarities and differences in conceptual content between parents and children. It was used because the way the score was created accounted for where children and parents specifically (i.e., on each item) vary within each concept subdomain. In other words, it captured more specific variation in the nature of the overall correspondence between parents and their children.

The summed correspondence score was calculated by comparing whether or not parents and children answered the same way for each property asked about. They received a score of "1" to indicate correspondence; and a "0" to indicate a lack of

correspondence. Those scores were summed for an overall correspondence measure. Overall, parent-child correspondence was lowest for God's body-dependent properties (2.2 out of 5). Parent-child correspondence was significantly higher for God's mind-dependent properties (3.3 out of 5). Correspondence was highest for germs' mind-dependent properties (3.5 out of 5), and significantly lower was correspondence for germs' body-dependent properties (3.0 out 5).

What follows here is a discussion on whether and how the following categories of factors impacted parent-child correspondence of the two entity concepts and their two conceptual sub-domains of mind- and body-dependent properties: (a) intrinsic attributes of the child including: theory-of-mind ability, age, working memory, and executive functioning, (b) characteristics of the parent (e.g., beliefs, behaviors, thinking style), (c) engagement of children in activities and discourse about the entity by parents, (d) parent-reported importance of the entity concept for their child, and (e) children's beliefs in the existence of the entities.

First, in order to understand the patterns in what predicts and relates to correspondence about to be discussed, it is important to keep in mind what would be required for an increase in parent-child correspondence to occur. For the concept of God's mind-dependent properties, an increase in correspondence would require (a) parents to assign God more psychological properties, and/or (b) their children to assign God fewer of them. For the concept of God's body-dependent properties, an increase in correspondence would require (a) parents to assign God more physiological properties, and/or (b) their children to assign God fewer of them. For the concept of germs' mind-

dependent properties, an increase in correspondence would require (a) parents to assign germs more psychological properties, and/or (b) their children to assign germs fewer of them. For the concept of germs' body-dependent properties, an increase in correspondence would require (a) parents to assign germs fewer physiological properties, and/or (b) their children to assign germs more of them.

### **Child Attribute Characteristics**

Cognitions in general, and about agents in particular, develop as part of dialectic processes between biological maturation and the sociocultural context in which thinking occurs (Gauvain & Perez, 2015; Heiphetz, Lane, Waytz, & Young, 2016). During the early-to-middle childhood years, children increasingly demonstrate a greater understanding of mental-states, causal reasoning, fantasy-reality distinction, and biology (Shtulman, 2009; Shtulman, 2017; Wellman & Liu, 2001; Wellman & Liu, 2004; Woolley, 1997). The following characteristics seem to account, in part, for these important shifts in children's understanding and additionally improve social learning: executive functioning, working memory, and theory-of-mind. For example, theory-of-mind ability has been linked to children's: (a) improved behavioral adaptation in non-social learning tasks, and (b) improved ability to assess and endorse knowledgeable (versus ignorant) people (Brosseau-Liard, Penney, & Poulin-Dubois, 2015; Sabbagh, Hopkins, Benson, & Flanagan, 2010). Theory-of-mind skills have also been shown to moderate the relationship between parents and children's concepts of God (Saide & Richert, 2017). The type of abilities relevant to theory-of-mind are inhibitory control, in particular, conflict inhibition; and working memory (Carlson & Moses, 2001). Executive

function and working memory are also related to children's selective trust in informants/socializing agents (Doebel, Rowell, & Koenig, 2016).

In this study, theory-of-mind, executive functioning, age, and working memory were all related to each other in predicted ways. For example, age had a significant positive relationship with all of the following: conflict inhibition, theory-of-mind, executive functioning, and working memory. Additionally, theory-of-mind was positively related to executive functioning, and working memory. This helps to indicate that the measures used were measuring what they were intended to measure; and notably, all were measured with previously validated measures. However, parent-child correspondence did not vary across any of these child attributes. It was originally hypothesized that they would moderate the relationships between the following and correspondence: child belief, child engagement, and parent reported entity salience (see Figure 1). However, theory-of-mind, executive functioning, age, and working memory were not significantly related to correspondence for concepts of God or germs, nor were they related to the difference scores for concepts of God and germs. These attributes did not significantly moderate, as they were hypothesized to do.

There are at least three possible explanations for why these attributes were unrelated given the previous research on their importance for social learning. First, the age range explored in this study may not have been large enough to capture the relevant variation in these attributes. For example, parents conceptualized God as a bodiless agent and germs as nonconscious agents; however, children conceptualized God as a bodied agent and germs as both nonconscious and non-living (more so relative to their parents).

It is unclear (from previous research and theory) at what point in development offspring come to conceptualize these agents in ways indistinguishable from their parents. Even though these age ranges were chosen in order to capture a time in development when these skills are becoming more sophisticated, it is possible that the age range of this study was too restrictive.

Second, the correspondence being picked up on here may be a result, primarily, of symbols in the environment being filtered through children's anthropomorphic cognitive bias. Therefore, children utilized their theory-of-mind, working memory, and executive functioning skills to a lesser extent than what was originally expected. Or rather, the level of theory-of-mind, working memory, and executive functioning need not be high because biases, rather than information gathered through social means, fill in the blanks. For example, children may see a depiction of Jesus and think "like a person". Children may hear or see this handwashing slogan along with a picture of boogers or dirt, "Spreading germs is OUT. Handwashing is IN!". Hence, the concept of germs as "not like a person". These simple associations could be the driver of correspondence during this development period (i.e., 5-8.9 years). If children's general anthropomorphic bias is indeed the central driver, and that is why the child attributes were not significant, then other important questions emerge. For example, when do these child attributes begin to impact the learning of God and germs from other people?

Lastly, children's own motivation to learn about God and germs was not measured in this study. Children form concepts through actively processing and interacting with their social and non-social environment (e.g., Piaget, 2006; Vygotsky,



1978). Children are not “passive conduits into which information pours” (Gelman, 2009, p. 117). Rather, conspecifics are necessary sources of information that children observe and interact with; and these skills (e.g., theory-of-mind) aid children in being active in their own learning (Gauvain & Perez, 2015; Gelman, 2009; Vygotsky, 1978). If a child is not interested in God or germs, it is likely that she or he will not devote much attention to acquiring information about God or germs from other people. Hence, the attributes measured (i.e., theory-of-mind and executive functioning) are inconsequential because children may not be motivated to employ them.

### **Parent Context, Entity Salience, & Child Belief**

Parent context in this study referred to factors that influence children’s development of concepts that would not exist without the parents. Parent context includes (a) characteristics of the parent (e.g., their beliefs, thinking style) and (b) the social learning opportunities parents create. For concepts of God, characteristics of the parent included (a) parents’ belief in the existence of God (i.e., religious belief), (b) how often they engage in activities related to God (i.e., religious behavior; e.g., attend church, pray), (c) parent affiliation with a religion (i.e., religious belonging), and (d) parent’s analytical thinking style. For concepts of germs, characteristics of the parent included (a) parents’ belief in the existence of germs, (b) pathogen-based disgust sensitivity, (c) contamination-based disgust sensitivity, and (d) parent’s analytical thinking style. For entity salience, parents were asked two questions on how important they view each entity to be for their child to (a) know about, and (b) believe in.

The testimony of others serves as one source of information for children about the world around them, particularly a source for children concerning phenomena, like God and germs, that children cannot experience directly on their own via perceptual observations (Harris & Koenig, 2006). Testimony need not be directed at the child but in this study, parents were asked how often they talk to their child about God and germs. Parents were also asked how often they engage in activities with their child associated with God and germs, which is a crude measure of the parent's engagement of their child in social learning processes. It is a crude measure because the nature of that engagement is unclear, children could have been involved in one or more of the following types of social learning processes: behavioral observation, sharing of knowledge in reciprocal interaction, explicit efforts to instruct and transmit knowledge, and participation in cultural activities (Gauvain & Nicolaidis, 2015).

The following two sets of relationships were hypothesized: First, characteristics of the parent would positively relate to and predict: (a) parent reported entity salience, (b) parental engagement of children in activities and/or discourse pertaining to the entities, and (c) children's belief in the existence of the entities. Second, the engagement of children by parents in activities and/or discourse about the entity, parent reported salience, and the child's belief in the existence of the entity would mediate the relationship between parent characteristics and parent-child correspondence.

**Parent Context: God.** All four of the characteristics of the parent examined were related to parent reported salience of God. Parent's analytical thinking style did not predict salience above and beyond parents' religious belief, behavior, and

belonging. This is likely because parent's religiosity also served as a proxy for analytical thinking style. One of the most consistent findings in the psychology of religion is that religiosity is negatively related to analytical thinking style among adults in the United States (e.g., Pennycook, Ross, Koehler, & Fugelsang, 2016). The factors of religious belief, behavior, and belonging were positively related to parent reported salience and together explained more than 70% of the variance in reported salience. Notably, the salience variable used here included both parent reported entity importance and the frequency of socialization opportunities (i.e., talk, activities) children were engaged in by parents. Correlational analyses and a confirmatory factor analysis (CFA) revealed that for parents, engagement of their children (i.e., in talk and activities) and reported importance of God (i.e., for children to know about and believe in) all significantly predicted the latent factor, *salience* (see Figure 2). How parents responded to the questions about the importance of the entity was undifferentiated from how often they reportedly engage their children in socializing behaviors related to God.

The parent characteristics of belief and belonging were related to children's existence judgments for God. Overall, characteristics of the parent significantly predicted reported salience and engagement of children in activities and/or discourse. Additionally, the relationship between characteristics of the parent and children's belief in God's existence was mediated by salience (see Figure 3). Taken together, the more religious the parent, the more they said it was important for their child know about and believe in God. The more religious the parent, the more often they reportedly engaged their children in activities related to God and talked to their child about God.

***Predicting Correspondence: God.*** How parent characteristics (e.g., belief, behavior, and belonging), salience (and child engagement in activities and discourse), and child's existence judgment were related to correspondence differed for mind-dependent and body-dependent properties of God. Parent characteristics, salience, and child's existence judgment were all positively and significantly related to correspondence of God's mind-dependent properties. Findings supported the following: child's belief in the existence of the entity mediated: (1) the relationship between parent characteristics and entity correspondence (via salience), and (2) the relationship between salience and correspondence. Although children's existence judgment was directly related to parent characteristics in correlational analyses, the best fitting structural equation model had them indirectly related. Salience mediated the relationship between parent characteristics and child's belief. Child's belief also partially mediated the relationship between salience and correspondence (see Figure 3). Overall, these findings provide support for the idea that characteristics of the parent increase parent-child correspondence for the concept of God's psychological properties during the early-to-middle childhood years. These findings also importantly demonstrate that parent characteristics impact correspondence through the social learning opportunities the parent creates, and through when children believe that the entity they are learning about is real.

This was not the case for God's body-dependent properties; salience, characteristics of the parent, and children's existence judgment did not relate to, or predict correspondence for body-dependent properties (see Figure 4). Notably, correspondence was lowest for body-dependent properties of God. It was originally

suspected that these factors may not play as large a role in correspondence for God's body-dependent properties, in part, because parents are significantly less likely to conceptualize God as having a body in the first place. One possible explanation for the discrepancy in these findings (as compared with correspondence of mind-dependent properties) goes back to how parents and children reason about God. Children's anthropomorphic reasoning (bias) during this developmental period may constrain and enhance the influence of parents on concepts of God. It is not cognitively demanding for parents to conceptualize a bodiless agent (Shtulman & Lindeman, 2015). But children's anthropomorphic reasoning rooted in the concept of person (human), coupled with reinforcing depictions and talk about God as a person, likely make it more difficult for them to conceptualize a bodiless "human." It may be cognitively demanding for children to conceptualize a conscious agent without a body because it goes against their anthropomorphic reasoning and experience with humans. Children's in person experience with humans (and themselves) strongly support the view humans have mental-states and bodies to house them—not one without the other. Anthropomorphic reasoning can also simultaneously enhance information that implies God has a mind. What it boils down to for children is that, if it has a mind, it has a body.

In further support of this idea, children's concepts of God's mind- and body-dependent properties were significantly and strongly related to each other, this was the case more so for younger children versus older children (i.e., correlation of .771 versus .430). The difference between children's concepts was smaller than the difference between parents' concepts of God. For parents, concepts of God's body- and mind-

dependent properties differed by more than one and a half standard deviations. The influence of parent context could have been reduced by children's anthropomorphic reasoning, similar to what other biases do to human reasoning (Gilovich, 1991/2008). Adults are better at suppressing their intuition, and being better at doing that likely helps them suppress anthropomorphic reasoning in favor of cultural narratives (Shtulman & Harrington, 2015).

**Parent characteristics: Germs.** Characteristics of the parent were first predicted to relate to how important parents consider the entity to be for their children to know about and believe in (i.e., salience), children's existence judgment about germs, and the frequency by which parents engage their children in germ-related activities and germ-related talk (i.e., child engagement). This was not the case, characteristics of the parent were not related to salience, child engagement, or child belief. There was one exception to this; parent's belief in the existence of germs was positively related to germ-related activities. However, there was little variation in parent belief in germs, 97% of parents reported to believe in germs with the highest level of certainty. Additionally, unlike for God-related salience and God-related activities/talk, germ-related salience and germ-related activities/talk did not make up a single latent construct. Salience was however, positively and significantly related to how frequently parents reportedly talk to their child about germs. Characteristics of the parent were related to each other; for example, parent's pathogen disgust sensitivity (i.e., concern with common disgust elicitors), was positively related to their contamination disgust sensitivity (i.e., disgust reactions based

on perceived threat of contagion transmission). Characteristics of the parent were not related to salience, child engagement, or child belief.

***Role in predicting concepts of germs.*** Despite the lack of relationships noted above, some hypothesized factors significantly predicted parent-child correspondence for the mind- and body-dependent properties of germs. For correspondence of germs' mind-dependent properties, child's existence judgment did not mediate the relationships between: (a) parent characteristics and correspondence or (b) salience and correspondence. Instead, child's belief was a direct significant predictor of correspondence of germs' mind-dependent properties. Although parent pathogen sensitivity (i.e., sensitivity to common elicitors of disgust) was not significantly related to correspondence of mind-dependent properties (it was trending), and the model fit best with it included (see Figure 5). Overall, mind-dependent correspondence was related to pathogen sensitivity and child's existence judgment.

For parent-child correspondence of germs' body-dependent properties, the relationship between salience and correspondence was mediated by germ-related talk. In other words, parents who reportedly think that it is important for their children to know about germs, reportedly talk about germs more often with their children. But that germ-related discourse was negatively related to correspondence, that discourse reduced correspondence in parent-child concepts of the physiological properties of germs. The importance of the entity seems to be partly communicated to children through child engagement. This study did not measure what it is that parents talked to their children about though. One possible explanation for why the relationship between germ-related

talk and correspondence was negative could be that during these social learning opportunities, parents made associations between germs and negative affect (i.e., germs are disgusting and do bad thing). If parents gave germs a negative connotation during these social learning opportunities, they could have reduced children's tendency to see germs as agents (Mezuliu, Abramson, Hyde, & Hankin, 2004). Parent's pathogen sensitivity was directly and positively related to correspondence (see Figure 6). In other words, the more parents were reportedly concerned with elicitors of disgust, the more their children corresponded with them about germs' physiological properties. Prior research (e.g., Stevenson et al., 2010) shows that parents engage in more exaggerated demonstrations (e.g., with facial expressions) of disgust with their young children, and so this disgust sensitivity measure may have been a proxy for the extent to which parents direct their children's attention to germ-related objects in the environment. If that is the case, directing children's attention to germ-related objects may give children a greater impression that germs have physiological properties, such as being "alive." Overall, body-dependent correspondence was related to germ-related talk, parent pathogen sensitivity, and salience (indirectly; i.e., as mediated by germ-related talk).

Overall, the structural equation models for the predictors described above for correspondence of both mind- and body-dependent properties of germs accounted for 9% of the total variance in correspondence. Even though the models for both sub-domains explained the same amount of variance; the correspondence of germs' body-dependent properties' model was more closely aligned with the hypothesized relationships between predictors. In other words, parent characteristics (i.e., pathogen sensitivity) and parent



reported salience were related to correspondence of the physiological properties of germs, but this was not the case for the psychological properties of germs. It was suspected that these factors may not play as large a role in correspondence for germs' mind-dependent properties, in part, because (1) parents do not conceptualize germs as having minds, and (2) even though parents and children did not grant germs psychological properties, different reasoning among parents and children may account for that same outcome.

There are several topics worth considering in lieu of the low explanatory power of the hypothesized conceptual model (see Figure 1) for germ-related psychological and physiological concepts; and for the lack of relationships found between characteristics of the parent, salience, and child's existence judgement for concepts of germs. First, the development period chosen for this study was chosen in part to reflect the transition of children to school settings. Even if parents still spend a considerable amount of time with their children, other microsystem level settings are also impacting children (Bronfenbrenner, 1994). Children cited school and teachers as the second most common source of information about germs. Additionally, germs are part of school curriculum (California Department of Education, 2009). Taking this into consideration, two possibilities emerge. First, parents may expect that teachers are already teaching their children about the biological facets of germs that parents know, and as such parents may not talk to their children about the biological nature of germs, rather just make sure they engage in behaviors to avoid illness (e.g., washing their hands, brushing their teeth, bathing). Related to this latter suggestion, research has shown that children who are unable to demonstrate any understanding of contagion (unlike their parents who can) still

demonstrate avoidant behavior in response to things that elicit disgust (i.e., negative affect) responses in adults (Stevenson, Oaten, Case, Repacholi, & Wagland, 2010). Parents may simply be socializing children's affective responses to situations that elicit disgust, but doing so does not require children's explicit understanding of why (e.g., germs are alive). Children in this study did not consistently conceptualize germs as being "alive," while parents did. This demonstrates that while parents may understand why (i.e., germ theory of disease) germs should elicit disgust, children do not. Along this same vein parents' pathogen sensitivity, not contamination sensitivity, was related to correspondence.

Second, children are converging with parents in their concept of germs' mind-dependent properties but different reasoning is likely causing both parents and children to state that germs do not have psychological properties. They are converging in that correspondence was highest for germs' mind-dependent properties (recall it was 3.5 out of 5), both children and parents generally did not assign germs mind-dependent properties. Children may not have granted germs psychological properties because they (a) do not see them as agents (i.e., as living), and (b) they associate them with "bad" things and are therefore not motivated to grant them properties that they associate with humans/ themselves. Parents on the other hand, though probably similarly motivated by negative beliefs about germs, are also informed by their germ theory of disease and mature understanding of biological kinds. In other words, parents understand that germs do not have mental-states because they are living organisms without brains. This results

in a similar outcome in concepts of God's mind-dependent properties, but different reasoning strategies led them there.

### **Conceptual Model: God versus Germs**

It was hypothesized that overall the conceptual model tested (i.e., Figure 1) would fit best for the religious-supernatural entity as compared with the scientific-natural entity for several reasons. Though concepts of God and germs are similar in some important ways (e.g., are nonspontaneous concepts, important to most people throughout the lifecourse), God and germs differ in (a) ontological status, (b) sources of cultural information, (c) motivations for behavioral engagement (d) emotionality and the collective nature of behaviors, (e) conception of consciousness, and (f) social identity. The model predicting correspondence with parent context explained the most variance for correspondence of the mind-dependent properties of God. The differences between God and germs partly account for this.

One particularly relevant difference between concepts of God and germs concerns where children learn about them. Talking about God in public school settings is formally prohibited, and at the very least, treated informally as taboo; and the majority of children in this study currently attend public schools (i.e., 85% of them). Additionally, God is absent from other secular domains of public life, in part because of a capitalist market orientation (i.e., businesses want to appeal to the broadest possible audience). While the primary information sources for God typically include parents/family and religious organizations, schools (i.e., secular organization) and teachers serve as *additional* information sources for germs (California Department of Education, 2009). In this study,

children's own responses to who they recall talking about God and germs with, is consistent with this. For example, children were twice as likely to say that they recall talking to a teacher about germs as compared with God (21.14 versus 41.46%), and were more likely to recall talking to their parents about God than about germs (65.85 versus 53.66%); notably however, more than half of children still recall talking to their parents about germs.

The conceptual model of correspondence tested here was primarily a model of parent context factors and did not incorporate school context factors or other settings where learning about germs may occur such as in medical, recreational, and/or food service. Children are subject to a greater distribution of sources of information about germs, and parents and children both take part in broader socializing contexts where this information is available. Parts of the conceptual model tested did apply to predicting correspondence of concepts of germs (as discussed earlier), but applied best for correspondence of God's mind-dependent properties. As a result, it is likely that parent context alone is less influential on concepts of germs. School context factors may be important for God-related concepts as well, but are likely more relevant to germ-related concepts more specifically, and scientific concepts more generally. Given the differences noted here in the mechanisms by which children learn about God and germs, future research may want to examine the development of these concepts separately. Previous research has included both God and germs in single studies sometimes on the basis that they each represent invisible entities (God in principle, germs in practice), however, this

study highlights that such a similarity is not enough to draw inferences on the relevant factors in children's reasoning about them.

Another likely explanation for the difference in the explanatory power of the conceptual model for God versus germs concerns the differing motivations for engaging in activities/behaviors pertaining to each entity. The motivations for parental engagement of children in entity-related activities is likely not lost on children who are active in their own socialization and cognitive development (Piaget, 2006). It has been highlighted throughout that while behaviors engaged in surrounding germs are part of everyday habits meant to increase cleanliness and to eliminate germs' existence; God-related behaviors are done as an attempt to communicate with God, regulate emotions, and as a signal or symbolic gesture of membership with the group that worships God. These differences in motivation for engagement may impact the degree to which children consciously attend to their parents while engaged in the behaviors. For example, everyday habits are done subconsciously, without concerted mental effort, and even though parents reportedly engage their children in activities related to germs on a regular basis, children may not apply much attention to those activities; especially if from the child's view, they are chores, not opportunities to learn about the nature of a germ.

### **Limitations and Future Research**

There are several limitations worth noting. The first is that while parents were asked how often they engage in behaviors pertaining to God (not necessarily with their child), they were not asked how often they engage in behaviors (e.g., hygiene, cleaning) associated with germs without their child. This study assessed parents' disgust sensitivity

with two measures, but that is not necessarily a measure of the frequency in which parents engage in behaviors reflective of that sensitivity. A measure of parents' engagement in germ-related activities, not necessarily with their child, may not have been informative, but this study had questions like that for behaviors pertaining to God, and a similar measure for germs would have led to a cleaner comparison in the models. Additionally, since the consistency between parents' beliefs and behaviors are important for transmission (e.g., Bader & Desmond, 2006; Bengston, Putney & Harris, 2013), how often parent engage in germ-related behaviors (e.g., cleaning) could have mediated the relationship between disgust sensitivity and parent-child correspondence of germ-related concepts.

Second, only one parent took part in the study—the parent that accompanied the child, which was typically their mother. It would have been useful to have had both parents, especially for concepts of God, for at least the following reason: consistency between parents plays a role in the transmission of religiosity (Bader & Desmond, 2006; Voas & Crockett, 2005). Accounting for a discrepancy between parents in conceptual content, should a discrepancy exist, could have been an important predictor of correspondence in this study. Previous research shows that concepts of God among adults differ between males and females (Shtulman & Lindeman, 2016), but this study could not control for gender among parents because most parents were the mother.

Third, another family-related constraint in this study was the inclusion of 23 siblings. In other words, 23 families in the study had more than one child participate. The findings presented here should be interpreted with this information in mind because

of the greater relatedness among children in this sample. It is possible that the results presented here are somewhat inflated (e.g., effect sizes are larger) given that children's answers are more related because siblings share greater genetic relatedness and parental environment; however, parents did fill out a separate survey for each child and preliminary analyses did not indicate meaningful differences in findings because of the addition of siblings. Future research may want to limit the use of siblings in this kind of research if the recruitment of dyads is amenable to it and/or account for the additional relatedness statistically should the sample size be amenable to it.

Fourth, even though these age ranges (5 to 9 years) for children were chosen in order to capture a period of development when certain skills (e.g., theory-of-mind, executive functioning) that facilitate learning and problem-solving tend to become increasingly sophisticated, the skills measured in this study were unrelated to correspondence. It is possible that children are not motivated to employ these skills for concepts of God and germs. Future research should inquire as to children's motivation to learn about the concepts they are being asked about as they are active in learning processes. It is also possible that the age range of this study was too restrictive to capture the relevant variation in these skills. Future research should recruit a wider age range of children to examine when these child attributes (i.e., skills) and the parent context factors become more or less important across development. For example, at least in the case of supernatural-religious concepts, adolescence appears to be a time when religiosity plays an increasingly important role in identity, social acceptance, and emotion regulation (e.g., Kuglemass & Garcia, 2015; Richert & Saide, in press).

Additionally, although the concepts and correspondence did not differ across child's age, another way to examine the effect of age would have been to test the conceptual models with younger and older children separately. This would have enabled a comparison of the weight of each factor. For example, children's engagement in God-related activities and/or discourse with their parent may have had a larger relationship with correspondence among older children in the study. Older children tend to be less anthropomorphic in their reasoning (e.g., Saide & Richert, 2017; Solomon & Cassimatis, 1999). As another example, the subscale on pathogen disgust sensitivity may have had a larger relationship to parent-child correspondence in older, as opposed to, younger children. However, the sample sizes within the younger and older groups was not large enough for that type of analysis.

Along this vein, the confirmatory factor analysis and structural equation analyses were already done with reduced sample sizes. The sample sizes here limited the type of analyses that could have been performed. For example, the confirmatory factor analysis (CFA) for parent reported salience of God concepts was not incorporated into the structural equation models predicting correspondence of the mind- and body-dependent properties of God. Incorporating the CFA would have required at least nine additional parameters to be estimated requiring a larger sample size. Instead, salience was created into an average of the four relevant variables (i.e., salience to know about God, believe in God, how often parents talk about, and engage in activities related God). The CFA and Cronbach alpha lent support for the creation of the salience index (i.e., with the four manifest variables) as a statistically and conceptual appropriate solution to the sample



size constraint in this study. However, future research should recruit for much larger sample sizes to broaden the type of analyses that can be performed.

Finally, given that this study inferred the degree of anthropomorphic reasoning children and parents utilized, it would have been informative to have included a measure of individual differences in anthropomorphic reasoning for both parents and children. This would have helped tease apart whether or not children and parents were using different reasoning to come to the same conclusions.

As a result of these limitations, future research should include more questions on the type of God- and germ-related behaviors parents and children engage in, recruit a larger number of parent-child dyads with both parents, and include individual difference measures in anthropomorphic reasoning. Additionally, future research should control for school context factors (e.g., germ-related activities, curriculum), teacher reported entity salience, and include measures of the concepts of teachers. This could have been especially important for concepts of, and the correspondence of, germs. This was outside the scope of this particular study but not unimportant; and future research could triangulate measures from parent, teacher, and child.

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## Appendix A

### Parent Questionnaire

What is your participant number? \_\_\_\_\_

#### **We have some questions about your child's background**

What is your relationship to the child in this study?

- Mother
- Father
- Aunt
- Uncle
- Grandmother
- Grandfather
- Other

What is your child's gender?

- Female
- Male
- Decline to state

When was your child born? (e.g., 01/01/2010) \_\_\_\_\_

How would you describe your child's ethnic background? (Check all that apply)

- White
- Hispanic/Latino
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Pacific Islander
- Black/African-American
- Other \_\_\_\_\_
- Decline to answer

Does your child attend a parochial (i.e., religious) preschool or elementary school?

- Yes
- No

#### **We have some questions about your background**

How old are you? (please put your age in years) \_\_\_\_\_

Please check the option that most accurately reflects your current relationship status:

- Married



- Widowed
- Divorced
- Separated
- Single
- Live-in partner
- Decline to answer

What is the highest level of education you have achieved?

- Did not complete High School
- High School Diploma or GED
- Some College/ Vocational School
- Associate's Degree
- Bachelor's Degree
- Advanced Degree

How often do you engage in *private religious practices* (i.e., at home)?

- Never
- Multiple times a year
- Once a month
- Twice a month
- Once a week
- Multiple times a week
- Daily

How often do you attend *events* sponsored by a religious organization (e.g., church services)?

- Never
- Multiple times a year
- Once a month
- Twice a month
- Once a week
- Multiple times a week
- Daily

What is your religious affiliation?

- None (no religious affiliation)
- Christian/Protestant
- Catholic
- Mormon
- Islam
- Jewish
- Buddhist
- Other (If other, what is it?) \_\_\_\_\_

**We have some questions about God**

Do you believe God exists in real life?

- Definitely does not
- Probably does not
- Don't know
- Probably does
- Definitely does

Please tell us about God: \_\_\_\_\_

We have some questions about God.

	Yes	No
Is God alive?	<input type="checkbox"/>	<input type="checkbox"/>
Can God grow old?	<input type="checkbox"/>	<input type="checkbox"/>
Can God eat food?	<input type="checkbox"/>	<input type="checkbox"/>
Can God breathe?	<input type="checkbox"/>	<input type="checkbox"/>
Does God have bones?	<input type="checkbox"/>	<input type="checkbox"/>
Can God know things?	<input type="checkbox"/>	<input type="checkbox"/>
Can God want something?	<input type="checkbox"/>	<input type="checkbox"/>
Can God see things?	<input type="checkbox"/>	<input type="checkbox"/>
Can God smell things?	<input type="checkbox"/>	<input type="checkbox"/>
Can God make plans to do something?	<input type="checkbox"/>	<input type="checkbox"/>

How often do you engage in activities and/or routines associated with God, with your child?

- Never
- Yearly
- Monthly
- Weekly
- Daily
- Multiple times a day

Please list ANY and ALL activities and/or routines associated with God that you engage in with your child: \_\_\_\_\_

How often do you talk about God with your child?

- Never
- Yearly
- Monthly
- Weekly
- Daily
- Multiple times a day

How important is it for your child to know about God?

- Not important at all
- Somewhat important
- Very important
- Extremely important

How important is it for your child to believe in God?

- Not important at all
- Somewhat important
- Very important
- Extremely important

**We have some problem-solving questions for you**

A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost? \_\_\_\_\_ cents.

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? \_\_\_\_\_ minutes.

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? \_\_\_\_\_ days.

If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? \_\_\_\_\_ days.

Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class? \_\_\_\_\_ students.

A man buys a pig for \$60, sells it for \$70, buys it back for \$80, and sells it finally for \$90. How much has he made? \_\_\_\_\_ dollars.

Simon decided to invest \$8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has:

- broken even in the stock market
- is ahead of where he began
- has lost money

The following items describe a variety of concepts. Please rate how disgusting you find the concepts described in the items, where 0 means that you do not find the concept disgusting at all and 6 means that you find the concept extremely disgusting.

	0. Not at all disgusting	1.	2.	3.	4.	5.	6. Extremely disgusting
1. Standing close to a person who has body odor.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Shaking hands with a stranger who has sweaty palms.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Stepping on dog poop.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Accidentally touching a person's bloody cut.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Seeing some mold on old leftovers in your refrigerator.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Sitting next to someone who has red sores on their arm.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Seeing a cockroach run across the floor.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please mark true or false.

- |   | True                     | False                    |
|---|--------------------------|--------------------------|
| 1. I never let any part of my body touch the toilet seat in a public washroom.                | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. I probably would not go to my favorite restaurant if I found out that the cook had a cold. | <input type="checkbox"/> | <input type="checkbox"/> |

Please rate how disgusting you would find the following experiences.

- |   | Not                      | Slightly                 | Very                     |
|---|--------------------------|--------------------------|--------------------------|
| 3. You take a sip of soda and realize that you drank from the glass that an acquaintance of yours had been drinking from. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. A friend offers you a piece of chocolate shaped like dog-doo.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. As part of a sex education class, you are required to inflate a new lubricated condom, using your mouth.               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**We have some questions about Germs.**

Do you believe Germs exist in real life?

- Definitely does not
- Probably does not
- Don't know
- Probably does
- Definitely does

Please tell us about Germs: \_\_\_\_\_

We have some questions about Germs.

- |                  | Yes                      | No                       |
|------------------|--------------------------|--------------------------|
| Are Germs alive? | <input type="checkbox"/> | <input type="checkbox"/> |

- |                                       |                          |                          |
|---------------------------------------|--------------------------|--------------------------|
| Can Germs grow old?                   | <input type="checkbox"/> | <input type="checkbox"/> |
| Can Germs eat food?                   | <input type="checkbox"/> | <input type="checkbox"/> |
| Can Germs breathe?                    | <input type="checkbox"/> | <input type="checkbox"/> |
| Do Germs have bones?                  | <input type="checkbox"/> | <input type="checkbox"/> |
| Can Germs know things?                | <input type="checkbox"/> | <input type="checkbox"/> |
| Can Germs want something?             | <input type="checkbox"/> | <input type="checkbox"/> |
| Can Germs see things?                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Can Germs smell things?               | <input type="checkbox"/> | <input type="checkbox"/> |
| Can Germs make plans to do something? | <input type="checkbox"/> | <input type="checkbox"/> |

How often do you engage in activities and/or routines associated with Germs, with your child?

- Never
- Yearly
- Monthly
- Weekly
- Daily
- Multiple times a day

Please list ANY and ALL activities and/or routines associated with Germs that you engage in with your child: \_\_\_\_\_

How often do you talk about Germs with your child?

- Never
- Yearly
- Monthly
- Weekly
- Daily
- Multiple times a day

How important is it for your child to know about Germs?

- Not important at all
- Somewhat important
- Very important
- Extremely important

How important is it for your child to believe in Germs?

- Not important at all
- Somewhat important
- Very important
- Extremely important

## Appendix B

### Child Interview

Remind child that, “There are no right or wrong answers to these questions, we are only interested in what you think about... <insert topic>”

Reality Status	Pretend (Really Sure)	Pretend (Little Sure)	Don't Know	Real (Little Sure)	Real (Really Sure)
Do you think your MOM is real or pretend?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you think GOD is real or pretend?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you think GERMS are real or pretend?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Concepts of God

Do you think it is important to know about God?

- No
- Yes, A Little Important
- Yes, Really Important

	No	Yes
Is God alive?	<input type="checkbox"/>	<input type="checkbox"/>
Can God grow old?	<input type="checkbox"/>	<input type="checkbox"/>
Can God eat food?	<input type="checkbox"/>	<input type="checkbox"/>
Can God breathe?	<input type="checkbox"/>	<input type="checkbox"/>
Does God have bones?	<input type="checkbox"/>	<input type="checkbox"/>
Can God know things?	<input type="checkbox"/>	<input type="checkbox"/>
Can God want something?	<input type="checkbox"/>	<input type="checkbox"/>
Can God see things?	<input type="checkbox"/>	<input type="checkbox"/>
Can God smell things?	<input type="checkbox"/>	<input type="checkbox"/>
Can God make plans to do something?	<input type="checkbox"/>	<input type="checkbox"/>

Can you tell me about God? What about God? What is God like? \_\_\_\_\_

Who did you learn about God from? \_\_\_\_\_

Have you ever talked to your friends at school about God?

- No
- Yes

Have you ever talked to your teachers at school about God?

- No

- Yes

Have you ever talked to your siblings about God?

- No
- Yes

Have you ever talked to your grandma or grandpa about God?

- No
- Yes

Do you ever talk to your mother/father about God?

- No
- Yes

Do you ever talk to anyone else about God?

- No
- Yes

If yes, who? What have they said about God? \_\_\_\_\_

# Now we are going to play a game on the iPad.

<Pull up the **Flanker Task** via the NIH Toolbox>

“Now we are going to play a numbers game.”

1. **Forward Digit Span Task:** Ask the child to recall a spoken list of numbers in order for the first task. Each digit will be spoken by the research at the rate of one digit per second. Begin with a practice session. If the child gets four sequences in a given list length correctly, then increase the difficulty by one additional number. The task will begin with single-digit lists and will progress in difficulty until the child recalls three trails of a particular length incorrectly.

2. **Backward Digit Span Task:** Ask the child to recall a spoken list of numbers in reverse order for the second task. Each digit will be spoken by the research at the rate of one digit per second. Begin with a practice session. If the child gets four sequences in a given list length correctly, then increase the difficulty by one additional number. The task will begin with single-digit lists and will progress in difficulty until the child recalls three trails of a particular length incorrectly.

### **Knowledge Access Task**

"OK. I now have a game for us to play! This is a guessing game." [Display toy box with top closed]: "Here is a Toy Box"

Pretest Question 1: What do you think is in it? \_\_\_\_\_ That's a good guess! Let's open it. Oh, look! There is a dog in it! [Display toy dog; then close the top.]

Control Question 1: So what is in the box? \_\_\_\_\_ [do not proceed until the child remembers it correctly]

- Dog
- Something Else

[Doll enters]: This doll has never seen this box before. He/she has never opened it.

Control Question 2: Has he/she ever looked in this drawer? (memory) [do not proceed until the child remembers it correctly]

- No
- Yes

Test Question: Does this boy/girl know what is in this drawer?

- No
- Yes

### **Contents False Belief Task**

Researcher: "OK. I now have another game for us to play!" [put the doll behind something]"

"I am putting \_\_\_\_\_ here so that he/she cannot see or hear us, okay? So \_\_\_\_\_ cannot see or hear us anymore, right?"

[Display closed Band-Aid box]: Here is a box.

Pretest Question 1: B. What do you think is in it? \_\_\_\_\_ That's a good guess.  
[If no answer, or answer other than "Band-Aids," tester continues: What is usually in a box like this? In the shops, what does a box like this have in it? After they answer, show them what is really in the box.

Control Question 1: Okay, so what is in the box? \_\_\_\_\_ [do not proceed until the child remembers it correctly]

- Candles
- Something Else

[Doll enters]: This doll has never seen this box before. He/she has never opened it.

Control Question 2: Has he/she ever looked inside this box? (memory) [do not proceed until the child remembers it correctly]

- No
- Yes

Test Question: What does this boy/girl think is in the box?

- Candles
- Band-Aids



### **Hidden Emotions Task**

Researcher: Researcher say, “OK. I have some more questions for you now”

Children see a sheet of paper with a happy, neutral, and sad face to check that the child knows these emotional expressions. The researcher points to each and asks the child to identify the emotion.

Here is a Matt [picture of back of head]. Matt and his friends were playing. A girl, Rosie teased Matt and the others all laughed. Matt did not laugh. He did not think it was funny. But Matt did not want the others to see how he felt. If they saw how he felt, they would call him a baby.

Real Emotion Question: How did Matt really and truly feel when everyone laughed and teased him? [Emotional face pictures are offered for pointing. If no answer, tester points in turn and says: Did he feel happy? Or okay? Or sad?]

- Sad
- Happy/Neutral

Reality Justification Control Question: Why did he feel [sad/ okay/happy]? \_\_\_\_\_

Apparent Emotion Test Question: How did Matt try to look on his face when everyone laughed at him and teased him? [Emotional face pictures are offered for pointing. If no answer, tester points in turn and says: Did he try to look happy? Or okay? Or sad?] \_\_\_\_\_

(Correct answer = less negative emotion for apparent emotion question [e.g., okay] than was given for real emotion question [e.g., sad])

- Sad
- Happy/Neutral

Appearance Justification Control Question: Why did he try to look [sad/okay/happy]?

### **Sarcasm**

Researcher says, “OK. I have some more questions for you now”

Show colored line drawing that shows the back of a girl’s and a boy’s head, raindrops, and a wet cake and other food on a picnic rug. The researcher reads the story aloud without any special intonation or emphasis.

Story: “The girl and boy are going on a picnic. It is the boy’s idea. He says it will be a lovely sunny day. But when they get the food out, big storm clouds come. It rains and the food gets all wet. The girl says: “It’s a lovely day for a picnic.”

Preliminary question: “Is it true, what the girl said?”

- No
- Yes

Test question: "Why did the girl say 'it's a lovely day for a picnic?'" \_\_\_\_\_

Comprehension control question: "Was the girl happy about the rain?"

- No
- Yes

**Change of Locations**

"Ok, we have one last guessing game to play. This is Sally/Tom favorite toy. Sally/Tom puts in this blue box to keep it safe."

"I want you to tell everyone that Tom/Sally puts his/her favorite toy in the blue box. Tell your Mom. Tell my friend\_\_\_\_\_."

"All done? Good, now I want you to go put Sally/Tom behind this pillow, so s/he can't see or hear us." Good! Now we are going to move the favorite toy to the white box."

Question: Where will Sally/Tom think his/her favorite toy is?

- White
- Blue

**Concepts of Germs**

Do you think it is important to know about Germs?

- No
- Yes, A Little Important
- Yes, Really Important

	No	Yes
Are Germs alive?	<input type="checkbox"/>	<input type="checkbox"/>
Can Germs grow old?	<input type="checkbox"/>	<input type="checkbox"/>
Can Germs eat food?	<input type="checkbox"/>	<input type="checkbox"/>
Can Germs breathe?	<input type="checkbox"/>	<input type="checkbox"/>
Do Germs have bones?	<input type="checkbox"/>	<input type="checkbox"/>
Can Germs know things?	<input type="checkbox"/>	<input type="checkbox"/>
Can Germs want something?	<input type="checkbox"/>	<input type="checkbox"/>
Can Germs see things?	<input type="checkbox"/>	<input type="checkbox"/>
Can Germs smell things?	<input type="checkbox"/>	<input type="checkbox"/>
Can Germs make plans to do something?	<input type="checkbox"/>	<input type="checkbox"/>

Can you tell me about Germs? What about Germs? What are Germs like? \_\_\_\_\_

Who did you learn about Germs from? \_\_\_\_\_

Have you ever talked to your friends at school about Germs?

- No
- Yes

Have you ever talked to your teachers at school about Germs?

- No
- Yes

Have you ever talked to your siblings about Germs?

- No
- Yes

Have you ever talked to your grandma or grandpa about Germs?

- No
- Yes

Do you ever talk to your mother/father about Germs?

- No
- Yes

Do you ever talk to anyone else about Germs?

- No
- Yes

If yes, who? What have they said about Germs? \_\_\_\_\_

## Appendix C

Table 9  
Concepts of God Correspondence: Correlations, Means, and SDs

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	M	SD
1. Correspondence: God's Mind	–																	3.325	1.667
2. Correspondence: God's Body	.057	–																2.197	1.535
3. Child Age	.144	.034	–															6.904	1.129
4. Conflict Inhibition	.174†	.032	.557**	–														82.430	13.829
5. EF: Backward Digit Span	.056	.112	.473**	.232*	–													2.660	0.950
6. Memory: Forward Digit Span	.094	.130	.293**	.234*	.029	–												4.770	1.230
7. Theory of Mind	.095	.033	.624**	.518**	.303**	.398**	–											3.230	1.085
8. God-related Activities (freq.)	.324**	.176†	.108	.000	.034	.090	.035	–										3.010	1.696
9. God-related Talk (freq.)	.417**	.074	.167†	.025	.098	.083	.092	.798**	–									3.420	1.488
10. Saliency: Know	.454**	.030	.134	-.028	.034	.013	.037	.719**	.765**	–								2.860	1.003
11. Saliency: Believe	.480**	.004	.134	-.032	.058	.019	-.002	.726**	.759**	.877**	–							2.800	1.086
12. Saliency: Aggregated Measure <sup>a</sup>	.460**	.077	.149	-.009	.062	.056	.044	.888**	.911**	.923**	.923**	–						-0.016	0.906
13. Child Existence Judgement	.293**	-.059	.076	.083	-.057	-.030	.083	.144	.147	.215*	.279**	.216*	–					1.210	1.467
14. Parent Belief in God	.423**	-.014	-.011	-.099	.002	-.048	-.065	.469**	.472**	.578**	.642**	.593**	.253**	–				1.040	1.411
15. Parent Religious Activities (freq.)	.325**	.064	.078	-.061	-.048	.085	.047	.812**	.770**	.757**	.721**	.839**	.156	.458**	–			1.955	1.904
16. Parent Affiliation	.400**	-.191*	.066	.044	-.070	-.109	-.041	.657**	.668**	.425**	.532**	.630**	.192*	.398**	.507**	–		0.746	0.438
17. Parent Analytical Thinking Style	-.265**	.114	.003	.094	.008	.134	.100	-.119	-.104	-.278**	-.323**	-.227*	.022	-.240**	-.104	-.339*	–	1.490	1.606

† < .10. \* p < .05. \*\* p < .01.

<sup>a</sup>This measure was an average of the z-scored answers for: salience-know, salience-believe, God-related activities, and God-related talk.

Table 14  
*Concepts of Germs Correspondence: Correlations, Means, and SDs*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	#	M	SD
1. Correspondence: Germs' Mind	—																	3.517	1.347
2. Correspondence: Germs' Body	.070	—																3.008	1.292
3. Child Age	.048	.093	—															6.904	1.129
4. Conflict Inhibition	.051	.033	.557**	—														82.430	13.829
5. EF: Backward Digit Span	-.022	.173†	.473**	.232*	—													2.660	0.950
6. Memory: Forward Digit Span	-.149	-.078	.293**	.234*	.029	—												4.770	1.230
7. Theory of Mind	.046	-.092	.624**	.518**	.303**	.398**	—											3.230	1.085
8. Germ-related Activities (freq.)	-.119	-.138	-.055	-.130	-.006	.096	.046	—										3.951	1.366
9. Germ-related Talk (freq.)	-.056	-.231*	-.026	-.043	.053	-.112	-.017	.221*	—									3.520	1.169
10. Salience: Know	-.041	-.188*	.052	.163†	.082	.044	-.018	.021	.381**	—								2.236	0.678
11. Salience: Believe	-.066	-.152†	.015	.157†	-.023	-.058	.013	-.014	.310**	.714**	—							2.203	0.746
12. Salience: Aggregated Measure <sup>a</sup>	-.058	-.183*	.035	.173	.030	-.011	-.002	.003	.372**	.918**	.933*	—						2.219	0.660
13. Child Existence Judgement	.192*	-.153†	.171†	.342**	-.001	.217*	.290**	.041	-.022	.027	.004	.860	—					1.460	1.147
14. Parent Belief in Germs	-.032	-.107	.015	-.046	-.017	.003	-.004	.196*	.003	.064	.050	.061	.074	—				1.970	0.178
15. Disgust: Pathogen	-.161†	.181†	.164†	.090	.108	-.094	.051	-.094	.082	.102	.078	.097	-.015	.242**	—			4.921	1.150
16. Disgust: Contamination	-.069	.036	.117	.012	.030	-.048	.094	-.140	.126	.115	.103	.118	-.033	.144	.430**	—		2.396	1.324
17. Parent Analytical Thinking Style	-.087	-.180*	.003	.094	.008	.134	.100	.119	-.058	-.076	-.042	-.063	.157	.085	-.143	-.179†	—	1.490	1.606

† < .10. \* p < .05. \*\* p < .01.

<sup>a</sup>This measure was an average of: salience-know and salience-believe.