

EXAMINING INTENTIONAL DESIGN BIAS IN CHILDREN FROM SECULAR
HOUSEHOLDS

by

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DEDICATION

I would like to dedicate this master's thesis to my family, who have supported me endlessly even though they have no idea what I actually do as a researcher.

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1. INTRODUCTION

There are two competing hypotheses for the development of belief in supernatural beings and forces. According to one—the *cultural exposure hypothesis*—religious beliefs are predominantly the result of cultural transmission (e.g., Harris & Corriveau, 2021). This hypothesis is supported by research comparing adults’ (particularly parents’) and children’s religious beliefs and research that examines the influence of adult testimony on children’s beliefs in supernatural and unobservable entities (Corriveau et al., 2015; Davoodi et al., 2018; Woolley et al., 2004). The competing hypothesis—the *dual process hypothesis*—asserts that such beliefs result from the interaction between natural cognitive tendencies and cultural socialization processes (e.g., Banerjee & Bloom, 2013; Boyer, 2008). Support for this theory comes from research that suggests that adults and children hold implicit religion-relevant biases, such as endorsing the reality of a purposeful creator and displaying teleological reasoning—the tendency to reason about entities and events in terms of purpose (Banerjee & Bloom, 2014; Järnefelt et al., 2018; Järnefelt et al., 2015; Kelemen & Rosset, 2009), that form the basis for culturally specific beliefs.

Much of the work supporting both hypotheses has explored beliefs in adults. However, the results from adult studies are unable to provide clear evidence that one hypothesis is stronger than the other because adults have already been exposed to cultural norms regarding religion and may be demonstrating religion-relevant biases brought on by years of cultural exposure. In order to determine which hypothesis is stronger, we need to examine the occurrence of religion-relevant biases in a sample of people that has experienced less interaction between cultural exposure and cognition. In contrast with

adults, children have experienced comparatively less cultural input, thus leading to the question of how children may differ from adults in their expression and conceptualization of religious ideas. Moreover, if certain religion-relevant biases are present early in development, then that indicates that they are less likely to be the result of cultural input.

Studies examining religion-relevant biases in children indicate that children display some biases, such as teleological endorsements for artifacts and natural kinds, by 4-5-years old (e.g., Kelemen, 1999). However, research with young children also reveals the early influence of adult (particularly parents') testimony on children's beliefs in religious and supernatural beings (Cui et al., 2020). Still other research provides support for early interactions between biases and cultural input. For example, work by Diesendruck and Haber (2009) suggests that teleological and essentialist biases (e.g., belief that an object's or entities' abilities are determined by its categorization or properties) may emerge naturally in development, but are reinforced by religious cultural input. Richert and Smith (2009) also assert that to thoroughly understand the development of belief, we must explore the cognitive foundations that predispose humans to certain religious concepts. They contend that religious concepts do not derive from a single cognitive starting point, thus the relationship between cultural input and belief (explicit and implicit) can be parsed apart further to determine when children display belief in certain religious concepts, as well as how much cultural input is needed to serve underlying predispositions.

One considerable limitation of previous research with children is that it has been predominately conducted with children from religious backgrounds or with children from unknown religious backgrounds in western societies where they have likely been exposed

to Christian beliefs and practices. This is problematic because research with children from these backgrounds can only show us how religion-relevant biases emerge in an environment that includes a religious cultural context. We need to examine how religion-relevant biases may emerge in developmental contexts that does not include explicit religious cultural input to gain a better understanding of the relative role of culture versus cognitive biases on the development of religious belief. Thus, studying children from secular environments provides the opportunity to get a clearer picture of the extent to which religion-relevant biases are present early in development when there has been little explicit cultural input regarding religion. Focusing on the development of religion-relevant biases in young children being raised in secular households will allow us to determine how influential early exposure to religious culture is on children's expression and conceptualization of religious ideas, essentially providing support for one of the two competing hypotheses regarding the origins of religious belief.

In the overview of the literature below, I will start by further discussing the two primary hypothesis regarding the development of belief in supernatural beings and forces, before turning to a review of their supporting research, previous methodology and its limitations, and then the present study.

2. HYPOTHESES ABOUT THE ORGINS OF RELIGIOUS BELIEF

As mentioned above, there are two competing hypotheses regarding the origins of belief in religious and supernatural beings: the cultural exposure hypothesis and the dual process hypothesis. This debate questions whether belief in religious and supernatural beings is learned through cultural input or if belief is a naturally-occurring component of a human's cognition?

The Culture Exposure Hypothesis

The cultural exposure hypothesis suggests that religious belief is predominantly due to cultural transmission and stresses the importance of explicit cultural exposure and testimony as the key reinforcements to belief development. Some proponents of the cultural exposure hypothesis draw from a cultural evolutionary perspective by pointing out how humans build and continue to build communities around religion beliefs as a means to support cooperative living (e.g., Sois & Alcorta, 2003; Wade, 2009; Wilson, 2003). Others assert that the cultural exposure hypothesis can be understood from a behaviorist point of view and claim that religious belief and practices are solidified through cultural learning (Gervais et al., 2011). As presented in a thought experiment by Gervais and colleagues (2011), if a person were to wake up hungry one day in an unfamiliar environment surrounded by strange people, how would the person decide their next step? How would the person decide what food was safe to eat? Gervais and colleagues (2011) make the argument that the person's next step would be determined by what they observed from the behavior and experience of those around them. Gervais et al. (2011) claim this is similar for religious belief development. Humans are not born with knowledge of religion, but they learn about it from teachings or by watching others

around them engage in religious practices. This indicates that children are more likely to develop the beliefs of the people they spend the most time around. Research has examined this relationship by comparing the beliefs of children and their parents, which I discuss further in the next section.

As additional support for the cultural exposure hypothesis, some researchers propose that the development of belief in invisible scientific is similar to the development of belief in invisible religious entities. In their review of recent research, Corriveau and Harris (2021) conclude that beliefs vary across domain (e.g., religious, scientific) and these beliefs are influenced by a person's surrounding culture. Specifically, children from a religious majority (e.g., religion practiced by the majority within a society) backgrounds display less confidence in their beliefs about reality of religious entities when compared with children from a religious minority (e.g., religion not primarily practiced within a society) backgrounds. Moreover, Corriveau and Harris (2021) suggests that the minority and majority status of a child's religious background may influence how they justify their beliefs about the reality of religious entities. Specifically, children from religious minority backgrounds reference their parents for justification and children from religious majority backgrounds reference the properties of the entity to justify their beliefs.

Support for the culture exposure hypothesis is evident in studies that compare children's beliefs to their parents (Cui et al., 2020). A study comparing beliefs in unobservable religious entities among secular and Christian Chinese parents and their children found that parental testimony played a key role in their children's beliefs about unobservable religious entities. Specifically, children from secular households expressed

skeptical beliefs that were consistent with their parents' beliefs, and children from Christian households expressed confident beliefs that were consistent with their parents. Because China is well-known for being a secular or atheist society (Rottman et al., 2017), the findings from this study—particularly those from Christian communities— highlights the role of cultural exposure (e.g., parental testimony) in the home in religious belief development.

Moreover, other studies (Corriveau et al., 2015; Payir et al., 2021; Vaden & Woolley, 2011) also indicate that religious cultural input at home influences children's beliefs about the reality of supernatural events and characters. In one study, 5-6-year-old children from secular and religious backgrounds were questioned on whether they thought a protagonist from a story was a real or fictional person. This study revealed that children from religious backgrounds were more likely than secular children to judge a protagonist from a religious and fantastical story as real (Corriveau et al., 2015). Vaden and Woolley (2011) found similar results when they examined 4-6-year-old's reality judgements of characters in religious and non-religious stories. Their findings indicated that children who were from a high family religiosity background or familiar with the presented story were more likely to judge the character as a real person after hearing a religious story (Vaden & Woolley, 2011). Another study examining whether 5-11-year-olds believe events violating ordinary causal regularities could really happen found that religious children were more likely than secular children to judge that a religious story could really happen (Payir et al., 2021). These studies lend support for the culture exposure hypothesis because they show how influential explicit religious culture is on children's beliefs by highlighting how children's beliefs often coincide with their family

background. Researchers have gone further to re-create the learned process of religious cultural socialization. For example, Bering and Parker (2006) found that 7–9-year-old children spontaneously attributed an unexpected event to an invisible supernatural being who was trying to send them a message when they were explicitly primed to expect this being to communicate with them in some way. This supports the culture exposure hypothesis by demonstrating how explicit teachings about supernatural entities can influence children's beliefs.

Moreover, there is evidence that reality judgements of scientific and religious entities are related to external religious input (Clegg et al., 2019). A study examining the reality judgements (e.g., beliefs about whether something is real or not real) of scientific and religious entities across U.S. and Chinese adults found there to be discrepancy in reality judgements for individuals who indicated low religiosity across both countries (Clegg et al., 2019). Specifically, adults low in religiosity were more likely to endorse the reality of scientific entities than religious entities. Moreover, studies show how family religiosity may influence children's beliefs in purposeful creation (Evans, 2000). Evans (2000) examined evolutionist and creationist beliefs in children and their mothers or guardians. As expected, the results indicated that children's beliefs were consistent with their parents. High creationist beliefs in parents were positively correlated with creationist beliefs in children and negatively correlated with evolutionist beliefs.

This previous work suggests that explicit religious culture is highly influential in children's and adult's beliefs about events and the natural world. Thus, it may be necessary to examine religious-relevant biases in groups of people who are not exposed to explicit religious teachings to determine whether such biases emerge naturally in

development or are the result of explicit exposure to beliefs about religious and supernatural beings.

The Dual Process Hypothesis

The other competing hypothesis regarding the origins of religious belief is the dual process hypothesis. This hypothesis states that religious beliefs result from the interaction between innate cognitive tendencies and cultural transmission. Specifically, this hypothesis states that humans are predisposed to believe in religious and supernatural entities and that culture reinforces these predispositions. To illustrate this hypothesis, Bloom (2007) makes an analogy between religious belief development and language development. Like language, religious belief is not present at birth, but rather it is developed from the immersion in a person's environment. As babies, humans can make noises, such as crying and laughing. In this analogy, these noises represent the innate cognitive tendency for humans to draw purpose from the world around them, thus, making humans predisposed to believe in religious and supernatural beings.

Some supporters of the dual process hypothesis state that very little cultural scaffolding is needed for humans to commit to religious belief (e.g., Pyysiäinen & Hauser, 2010). Instead, those who support this hypothesis believe religion to be a cognitive byproduct of a number of different inherent religious-relevant biases. There are several known religion-relevant biases that humans demonstrate, but I will primarily discuss two—teleological reasoning and intentional design bias—because these biases have shown to be the most relevant from a developmental perspective and there is a growing body of literature examining them in children.

Teleological Reasoning

The tendency to reason about entities and events in terms of purpose is known as teleological reasoning (Kelemen, 2004). Those who exhibit teleological reasoning might say “everything happens for reason” after a spontaneous or unexpected event (Banerjee & Bloom, 2015), providing a function for that event in the scheme of their lives. This stems further to attributing purpose to objects and natural kinds as well. For example, children often give function-based explanations for natural objects (Banerjee & Bloom, 2013). If you were to ask a child, “why do clouds exist” they might respond by saying, “to block the sun on a hot day” or “to make rain”. In the case of these responses, the child displays teleological reasoning by explaining that clouds exist for a functional purpose. Moreover, there are two theories regarding the emergence of teleological thinking in children—selective teleology and promiscuous teleology (Kelemen, 1999). Selective teleology asserts that children can determine the function of biological parts, such as ears, because humans, specifically children have an innate tendency to construe purpose function for all objects. Promiscuous teleology argues that the ability to infer purposeful function stems from children’s understanding of agency and intentional object-directed behavior, and because of this, children apply teleological thinking more broadly when they are young and become more selective as they age (Kelemen, 1999).

As previously mentioned (e.g., see Cultural Hypothesis section), adults and children with religious backgrounds are more likely to explicitly endorse purposeful reasoning for events and artifacts. However, there is a body of research that supports that purposeful reasoning, and even purposeful creation, is endorsed in adults who do not identify as religious (Banerjee & Bloom, 2014; Järnefelt et al., 2015). These studies

highlight the presence of religion-relevant cognitive biases in humans which lends support for the dual process hypothesis.

Research examining teleological reasoning highlights the presence of religion-relevant cognitive biases in early development and in adults from all religious profiles (Kelemen, 1999; Järnefelt et al., 2015). In one study, Kelemen (1999) examined the teleological judgements of artifacts and natural kinds across children and adults. The results indicated children were more likely than adults to assign function or purpose to objects and natural kinds, along with their parts. Banerjee and Bloom (2015) examined if this purpose-based tendency among children was also applied to life events. In a study, 5-6-year-olds, 8-10-year-olds, and adults were asked to choose from a series of explanations for a cause that best explained the occurrence of certain life events. Overall, children were more likely than adults to choose purpose-based explanations for the cause of life events, however, this tendency reduced as age became greater. Further support for the dual process hypothesis comes from research that highlights how adults from all religious profiles display teleological reasoning and intentional design bias (Banerjee & Bloom, 2014; Järnefelt et al., 2015).

The tendency to infer design and purpose in life events is a feature of both religious believers' and, to a lesser extent, non-believers' explanatory reasoning. In a study, Banerjee and Bloom (2014) examined teleological reasoning for life events among adults who identified as believers and non-believers. The results indicated that adults who identified as believers in God were more likely than non-believers to endorse teleological explanations for life events. However, the tendency to infer teleological explanations for

life events was still present, to a lesser extent, in adults who identified as non-religious (Banerjee & Bloom, 2014).

Teleological reasoning is a great candidate for exploration in children, however, it requires active researcher participation to help scaffold the studies because they are usually text or statement based. Currently, conducting a study with active in-person researcher participation is not being considered due the on-going COVID-19 pandemic and limitations regarding recruitment. Instead, I wanted to conduct an online asynchronous task that can be completed without researchers present. Because of this, the proposed study will examine another bias of interest—intentional design bias.

Intentional Design Bias

The belief that natural kinds (e.g., rocks, animals, and nature) were purposefully created by “some being” is known as intentional design bias (IDB). Notably, it is not important if the said “some being” is connected with a certain religion. Previous impressions of intentional origins of natural phenomena have been restricted to individuals who explicitly believe in a monotheistic God. However, evidence suggests that explicitly theistic belief in a creator God is not the sole cause for the expression of intentional design bias (Järnefelt et al., 2018). Studies show that intentional design beliefs are displayed implicitly by those who do not identify as believers in a creator or God (Järnefelt et al., 2015; Järnefelt et al., 2018).

Research has shown that secular or creation-denying adults will demonstrate implicit intentional design bias, especially when placed under cognitive stress (Järnefelt et al., 2015). In a study examining intentional design beliefs among adults who identified as believers and non-believers, the results indicated that both groups displayed a tendency

to endorse purposeful creation for objects and natural kinds. These studies lend support for the dual process hypothesis because they indicate implicit beliefs in purposeful creation of objects and events. A following study examined whether this tendency is present in Chinese adults from a non-Western culture not rooted in Abrahamic beliefs (Järnefelt et al., 2018). Similar to studies conducted with adults from Western cultures, the results designated a tendency to construe intentional creation of natural phenomena under cognitive load. Because China is a well-known atheistic society (Farha, 2012) not rooted from Abrahamic monotheism, this study provides support that intentional design bias may not be the result of western religious culture, but instead, stem from a universal innate cognitive bias to endorse intentional creation of natural phenomena.

3. LIMITATIONS OF PREVIOUS RESEARCH

Prior research examining cognitive biases has primarily used adult participants, who have experienced years of cultural exposure. This poses a problem because years of cultural exposure also consists of years of religious cultural input as members of a pluralistic society that may influence their explicit and implicit beliefs in religious and supernatural beings and forces. Even adults who identify as non-religious experience religious exposure. Therefore, it is difficult to conclude that any demonstration of implicit belief of intentional creation or purposeful function of events from non-religious adults is the result of religious-relevant cognitive biases that have always been present or if they are the result of years of unnoticed cultural exposure. Moreover, studies examining cognitive biases in children have not placed specific recruitment criteria regarding religiosity or belief identity. Though children have been exposed to less cultural input this poses an issue because children may demonstrate biases that they have learned explicitly or implicitly from their parents. Therefore, it is difficult to conclude if previous observed religious-relevant cognitive biases in children is due to an innate tendency that is present at birth or the result from unnoticed parental influence.

4. PRESENT STUDY

The main goal of the present study was to determine whether or not we could examine children's beliefs about intentional design through an online platform with the eventual goal of launching an asynchronous study. In the present study we explored IDB in 4-7-year-old children using the asynchronous platform Gorilla (<https://gorilla.sc/>) with synchronous moderation from an experimenter. We decided to study IDB with young children because previous methods (e.g., picture-based tasks) examining this cognitive bias in adults are accessible for children, however, this task has not been previously validated with children. During the study, children were presented with an online image-based task similar to creation tasks used in previous studies (Järnefelt et al., 2015; see below), however this task was altered in image content, response accessibility, and reading level to make the activity “kid-friendly”. We believe that studying children will provide an opportunity to gain a clearer picture of how religious-relevant cognitive biases develops when there is little broader cultural input.

Methods for examining IDB and adaptations for research with children

Previous methods for examining IDB in adults have primarily consisted of image-based tasks that are designed to measure an individual's explicit and implicit belief of intentional creation. In these studies, the participants were presented with a series of pictures of living and non-living “natural” entities (e.g., fish, tree, rock, river) and asked to decide if the object or entity in the picture was “purposely made by some being” (Järnefelt et al., 2015; Järnefelt et al., 2018). Further, this method was used to measure implicit intentional design beliefs by introducing a cognitive load with a speeded task during which participants would be given a limited time to respond to each item. Such

studies primarily used a between-subjects design, so participants were randomly assigned to a self-paced task or a speeded task (Keleman & Rosset, 2009). The speeded version is meant to draw out an automatic response that represents the participants' implicit beliefs regarding purposeful creation of natural kinds. For some, this implicit belief is consistent with their explicitly expressed belief and for some it is not. On the other hand, the non-speeded task is meant to measure participants' explicit beliefs regarding purposeful creation of natural kinds.

Other studies randomly assigned participants into one of four “human-made” and “being-made” conditions to compare purposeful creation beliefs across speeded and self-paced tasks within each condition (Järnefelt et al., 2018). In these tasks, the participant was shown a series of pictures and asked to decide if the thing in the picture was made by “some human” or “some being”, respectively. These conditions were used to examine participants' understanding of instructions and to compare explicit and implicit endorsement of intentional creation across natural kind items. The limitations of previous methods include the use of adult populations (see previous limitations section), and the between-subjects design. This design poses a problem because it is difficult to assess the extent to which explicit and implicit beliefs are linked. Because image-based tasks can be understood by those who are not fully literate, they pose as an appropriate measure for exploring intentional design bias in children.

To our knowledge, our study is the first attempt at approaching this procedure with children, which highlights its necessary addition to the literature. Contrary to previous methods this study did not require children to complete a speeded creation task. Early piloting with 4-7-year-old children revealed that children needed repetitive

instructions and enough time to think about their responses during the self-paced task, thus we decided to exclude a speeded task.

Hypotheses

To our knowledge the current study is the one of the first attempts to examine intentional design bias in children and the first to examine it through an online platform. The findings of this study are exploratory and provided us with knowledge of how children respond an online assessment of IDB. Our overall goal was to examine if children respond to the online task well– such that they understand the goal of the task and respond in a manner that tell us that they conceptually know the difference between the different kinds of items presented--then that opens the door to potentially launching a similar asynchronous task to examine intentional design bias and other religion-relevant cognitive biases with secular children in the future. If we failed to find any patterns that suggest similar response patterns to adults across item categories, then that could indicate one of two things: 1) the task needs to be modified to make it more feasible for 4-7-years old children, or 2) children between the ages of 4-7-years cannot discern the difference between item categories.

Conclusion

In summary, what we know about the origins of religious belief stems from two major hypotheses, and these hypotheses have shaped past and present studies in regard to theory of interest and methodology. Moreover, the dual process hypothesis still encompasses some unanswered questions about the development of religion-relevant cognitive biases. Specifically, the question of whether intentional design bias is an innate cognitive tendency or a result from outer cultural influence has not been fully answered.

The aim of the current study was to pilot and norm an online task to examine intentional design bias, with the eventual goal of launching a similar study with children from secular households specifically.

5. METHOD

Design

This study will be a within-subjects examination of children's evaluations of three different *item types* (i.e., test item, yes control item, no control item).

Participants

In total, 28 children (4-7-year-olds) participated included in the present study. These children were recruited through social media. Though we set out to recruit only children from secular households, this limited the number of families we were able to include in the study. Therefore, we broadened the scope of recruitment to families with children within the ages of 4 and 7 years old. Because the goal was to pilot the task, we did not gather information about the religiosity status of all the families included or additional demographic information.

Measures

This study used a modified version of a picture-based task used in previous studies to examine intentional design bias in adults (Järnefelt et al., 2015; Järnefelt et al., 2018). The original task included 120 pictures with three item types (i.e., test items, yes controls, no controls; described below). Moreover, participants were instructed to select a certain key on the keyboard to answer “Yes” or “No” to indicate whether they “believed the thing in the picture was purposefully created by some being” (pg. 74, Järnefelt et al., 2015). The task was modified from the adult version to include “kid-friendly” images, response buttons, and language. The task included the same item types as the adult studies: *test items*, *yes control items* (divided into *artifacts* and *cartoons*), and *no control items* (see Appendix A for an example of each). The test items were images of natural

kinds (e.g., lion, rock, hurricane). The yes control items were images of human-made artifacts and cartoons (e.g., a kite or Winnie the Pooh). In adult studies, these items were meant to monitor “no” biases from participants who may have wanted to deny creation of all test items. These items would require them to pay attention and select “yes” at times. In current study, we decided to examine the proportion of yes responses for artifact and cartoon items separately because we anticipated that children may endorse intentional creation across these two categories differently unlike adults. Younger children may have a better understanding of man-made artifacts being created by someone; however, we were unsure whether they can understand drawings of natural kinds as purposely made. For example, if children see a drawing of a donkey, would they make a decision about the animal depicted or the drawing itself? The no control items were images of blue shapes. Participants were instructed at the beginning of the task to give a no response when they were presented with a blue shape to show they were paying attention. These items are meant to monitor “yes” biases from participants who endorse creation of all items.

Procedure

Children completed an image-based task through the online platform Gorilla Experiment Builder (<https://gorilla.sc/>). Before children began the task, they video-chatted with an experimenter on Zoom who helped them to set-up the study and share their screen so that the researcher could monitor their progress and help if necessary. During the task participants were video recorded. At the start of the task, children watched a series of video instructions from a research assistant. In the instruction videos, the research assistant started by speaking to the parent and requesting that they let their children complete the task independently. Following this video, the research assistant

gave instructions to the child for the game in the task by saying, “In this game you’ll see pictures of different kinds of things. You will also see blue shapes. Each time you see a picture of something, your job is to decide if someone made the thing in the picture or if the item in the picture just happened”. In the task, there were two buttons below the picture on each screen. If the child thought that someone made the thing in the picture, they were instructed to select the green thumbs up button on the screen (see Appendix A). If the child did not think that someone made the thing in the picture, they were instructed to select the red thumbs down button on the screen (see Appendix A). Before beginning the task, each child was prompted to warm up with a set of eight practice images followed by a break. Children were given feedback during the practice images if they selected “yes” for the blue shapes (no control items) that they should select “no” when they see a blue shape. Once the child was ready, they could proceed to the first block of images of the task and evaluate 12 images without feedback. Children evaluated five blocks of 12 images. The order of the blocks and the order of the images within the blocks were randomized. Between each block there was an untimed break where the child would see a fun video that indicated their progress to encourage the child to complete the task. Children were encouraged to take as much time as they needed before proceeding to the next block.

6. RESULTS

Overall proportions of ‘yes’ responses (indicating that the target item was made by someone) were calculated by collapsing across all participants to examine total responses for each item category. As indicated in Table 1, children were most likely to indicate a ‘yes’ for artifacts and least likely for the no control items (i.e., blue shapes that the children were instructed to answer ‘no’ in response to). This initial examination indicates that artifacts seemed to be serving as yes controls (i.e., items that participants should consistently respond ‘yes’ to) and that the blue shapes were effective no controls. Cartoons were also meant to serve as yes controls, but the proportion of yes responses for this category was less than that of the artifact category. Children selected ‘yes’ for natural items close to 50% of the time, so these items appeared to be treated differently than items from the other categories. Thus, in the analyses reported below, we had two main questions: (1) Were children responding differently to the test items (e.g., natural kinds) versus the other three categories? (2) Were children responding differently to the artifacts and cartoons, such that cartoons cannot serve as yes control items?

A mixed-effects binary logistic regression was performed to test the effects of item category (4: test items, artifacts, cartoons, and no items; dummy-coded with test items as the referent) and age (in years: 4, 5, 6, 7) on participants’ likelihood of responding “yes”. Given that participants’ responses were recorded for multiple items in succession, and they were not independent, a random effect of participant was included to control for the non-independence of responses. The logistic regression model was fit to a probit curve due to the smaller sample size. There was a significant effect of item category, such that children were more likely to select ‘yes’ when they saw an artifact

(OR [odds ratio] = 3.46, $p < .001$) or cartoon ($OR = 1.70$, $p < .001$) and less likely to select ‘yes’ when they saw a no control item ($OR = 0.19$, $p < .001$) compared to natural items. There was not a significant effect of age ($OR = 0.74$, $p = .112$). See Table 2 for a summary of the full mixed-effects logistic regression model. Overall, the results of this analysis indicate that children were responding differently to the test items than to the other three types of items.

To examine whether participants were responding similarly to the cartoon and artifact categories, a mixed-effects binary logistic regression was performed to test the effects of item category (2: artifacts and cartoons, dummy-coded with cartoon as the referent) and age (in years: 4, 5, 6, 7) on participants’ likelihood of responding “yes”. We also included an interaction between item category and age to examine if age impacted response to each item type differently (e.g., older children might be better at understanding that cartoons are created by someone). As in the analysis above, a random effect of participant was included, and the model was fit to a probit curve. There were not significant effects of item category ($OR = 4.30$, $p = .236$) or age ($OR = 1.30$, $p = .184$) and there was not a significant interaction between item category and age ($OR = 0.87$, $p = .544$). This analysis indicates that—statistically—children were not responding differently to cartoon and artifact items.

7. DISCUSSION

The purpose of the present study was to determine whether we could examine children's beliefs about intentional design bias through an online experiment platform. To do this, we presented children with a modified version of an image-based task previously used with adults that instructed them to decide whether a series of items was "made by someone". Results indicated differences in the proportion of 'yes' responses between the item categories of interest. Children were more likely to respond 'yes' when they were presented with a human-made artifact item, followed by cartoon items (also human-made), and were least likely to respond 'yes' to no control items (e.g., blue shapes that they were told to select 'no' for). Children responded 'yes' when they were presented with a test item (e.g., natural kinds) about half the time.

Children's responses indicated that this task can be successfully used with children in an online setting. Considering that blue shapes were meant to ensure that participants did not default to selecting the yes response throughout the entire task, it appears that these items served as sufficient no controls. Moreover, we expected there to be a high proportion of yes responses for the yes controls (e.g., artifacts and cartoons) if children understood the difference between "man-made" objects and natural kind objects. Results indicated that children understand that artifacts are made by someone; however, cartoons were not as highly endorsed. Further analysis comparing the proportion of yes responses between artifact and cartoon items revealed that children did not respond statistically different to the two item categories. Since children were more likely to responded yes to both artifacts and cartoons compared to the test items (e.g., natural kinds) as well, this tells us that these items served as sufficient yes controls for young

children. Thus, the different categories of control items seem to be interpreted by children in the same way that they are treated by adults (e.g., Järnefelt et al., 2015). It was encouraging to see that natural items (the test items) were judged differently from the control items, rather than being at ceiling (e.g., overwhelmingly judged as being created by something) or at floor (e.g., consistently judged as not created by something). This means that there is some variability in how children respond, allowing for us to examine variability in IDB in the future.

Next steps

Overall, we are interested in exploring intentional design bias in children, and in particular secular children, because they are a population who has both little experience with external cultural input and religious culture influence. Adult studies examining intentional design bias have revealed that both religious and non-religious adults endorse intentional design beliefs, especially when put under cognitive load. However, these results can only tell us a limited amount of information about the development of intentional design beliefs. Because adults have years of experience of cultural input whether it be through direct or indirect exposure, we cannot confidently say that intentional design beliefs are naturally present in everyone.

Moreover, examining children from secular households specifically is the best opportunity to examine children who have not been exposed to explicit religious culture. Previous research tells us that children's beliefs consistently align with their parents (Corriveau & Harris 2021; Cui et al., 2020). Even in regions of the world where Abrahamic religious beliefs are not the norm, children will explicitly endorse the same Abrahamic beliefs of their parents (Cui et al., 2020). Therefore, we cannot simply

examine children from any religious background in future studies to determine if intentional design beliefs are naturally emerging or the result of cultural influence. A study with children from secular children could have one of two results relating to support for either the cultural input hypothesis or dual process hypothesis. The first possibility is that we find that children from secular households do not endorse intentional design beliefs. These results would indicate a low proportion of yes responses for test items, high proportion for yes control items, and a low proportion for no control items (see Appendix B). The second possibility is that we find that children from secular households do endorse intentional design beliefs. These results would indicate a high proportion of yes responses for test items, high proportion of for yes controls, and a low proportion for no control items (see Appendix A).

In the future, we are also interested in further examining response proportions from this and future studies based on two other factors. First, we are interested in examining whether children responded differently to test items based on the type of picture and item shown. Consistent with past studies, the natural items included a variety of kinds of pictures: some showed a whole item and others showed (ex. a picture of a cat's ear compared to a picture of a whole cat), some showed naturally-occurring non-living items (e.g., rocks), others plants, and others animals. We want to examine if children respond to all of these items in similar ways. Secondly, we are interested in comparing if children are responding differently to cartoons of items that are familiar to most children compared to cartoons of mundane, everyday items. For example, are children responding differently when they see a cartoon of Eeyore from Winnie the Pooh compared to a cartoon of an eye.

In summary, the current study was an examination of intentional design bias in children through an online platform. To our knowledge, this was the first attempt to examine religion-relevant cognitive biases in children through an online platform. The findings indicated that children responded appropriately to control items and displayed critical variability in their responses to the test items. Considering the results from the current study, we believe there is potential to examine intentional design bias and other religion-relevant cognitive biases in children with similar asynchronous online tasks. Future directions would include specifically recruiting children from secular or non-religious households to complete these tasks asynchronously online. Such studies would bring researchers one step closer to understanding whether intentional design beliefs are naturally emerging cognitive biases or the result of cultural socialization.

Table 1

Proportion of yes responses across item category (e.g., Artifact, Cartoon, Test items, & No items)

	Artifact	Cartoon	Test Items	No Items
Proportion of Yes responses	.83	.63	.46	.09

Table 2

A mixed-effects binary logistic regression for effects of item category and age of participants likelihood to respond ‘yes’

Model	Predictor	β	<i>SE</i>	<i>p</i>	<i>OR</i>	95% confidence interval
<i>Model 1</i>						
Impact of item category and age	Intercept	1.54	1.05	.141	4.69	[0.60, 36.59]
	Age	-0.30	0.19	.112	0.74	[0.51, 1.07]
	Item category vs. Test Items					
	Artifact	1.24	0.15	<.001***	3.46	[2.60, 4.62]
	Cartoon	0.53	0.13	<.001***	1.70	[1.31, 2.19]
	No Items	-1.70	0.10	<.001***	0.19	[0.15, 0.23]
<i>Model 2</i>						
Examining difference between potential yes controls	Intercept	-1.05	1.11	.341	0.35	[0.04, 3.05]
	Age	0.26	0.20	.184	1.30	[0.88, 1.93]
	Artifact (vs. Cartoon)	1.46	1.23	.236	4.30	[0.39, 47.91]
	Artifact*Age	-0.13	0.22	.544	0.87	[0.57, 1.35]

*** $p < .001$

APPENDIX SECTION

APPENDIX A: Images of the response buttons and examples of each item category



Green thumbs up button



Red thumbs down button

Item category examples





Test items: Living and Nonliving naturally-occurring objects



Yes control items: artifacts and cartoons



No control items: Blue shapes

APPENDIX B: Anticipated results figures for secular children studies

Figure B1

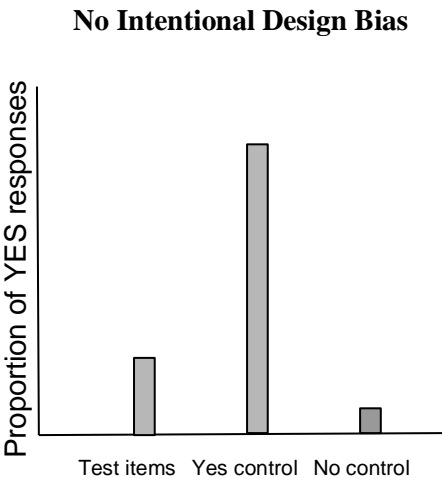
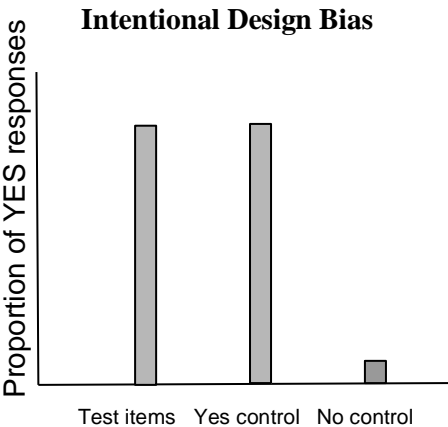


Figure B2



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