



Developmental Changes in the Use of Supernatural Explanations for Unusual Events

Jacqueline D. Woolley*, Chelsea A. Cornelius and Walter Lacy

Department of Psychology, The University of Texas at Austin, 1 University Station,
A8000, TX 78712, USA

*Corresponding author, e-mail: woolley@psy.utexas.edu

Abstract

The focus of this research is to explore the developmental trajectory of the propensity to see meaning in unexpected or chance events, and more specifically, to explore the origin and development of nonmaterial or supernatural explanations. Sixty-seven children aged 8, 10 and 12, along with 22 adults, were presented with scenarios describing unusual or unexpected events. They were first asked to provide explanations for why they thought the events occurred and then asked to rate different supernatural explanations (moral justice, God and luck) as they pertained to each scenario. Results indicated that adults spontaneously appealed to supernatural explanations more frequently than did children, and that this tendency to appeal to supernatural concepts increased with age. Participants of all ages frequently endorsed multiple explanations for the same events and were more likely to endorse supernatural explanations for positively valenced than for negatively valenced stories. Religiosity affected both spontaneous explanations and ratings. Findings are discussed in terms of how children acquire the explanatory systems of their culture.

Keywords

Supernatural explanations, moral justice, religion, explanatory systems

Beginning with Piaget (1929), children's reasoning about the causes and consequences of events has been a central issue in developmental psychology. Thus far, researchers have discovered that when asked to reason about a variety of cause and effect relationships, children exhibit a level of sophistication often comparable to that of adults (e.g., Rosengren and Hickling, 1994; Hickling and Wellman, 2001; Keil, 2006; Gopnik and Schultz, 2007; Legare et al., 2009). In addition, children exhibit specificity in their reasoning, offering explanations that draw on principles central to the events they are explaining. For example, Hickling and Wellman (2001) showed that young children consistently assign biological explanations to biological events and physical

explanations to physical events. To date, the best understood of these explanations are those that derive from children's naïve theories of physics, biology, and psychology (e.g., Carey, 1985; Wellman and Gelman, 1992; Inagaki and Hatano, 2006; Keil, 2006; Spelke and Kinzler, 2007). Although we know much about how children explain everyday events such as objects colliding, animals growing, and people lying, we know very little about how children explain unusual or unexpected events. Such events are, by definition, uncommon in children's lives. Yet children's explanations of these sorts of occurrences have the potential to prove revealing about their basic ontological commitments (Wellman, 2011).

Like children, adults use primarily natural constructs to explain common events in their everyday lives. Yet research reveals that adults also use an entire set of nonmaterial or supernatural explanations when asked to explain unusual or unexpected events. Pepitone and Saffioti (1997), for example, presented adults with a variety of what they termed "difficult-to-explain" events and solicited spontaneous explanations. These events were constructed to be both highly significant and hard to interpret in natural terms. Examples of these difficult-to-explain events were a woman who inexplicably recovers from a chronic illness and a man who reunites with his long-lost brother while on a remote island vacation. These sorts of events often violate expectations, either because they are inconsistent with naïve theories or because they defy probability. Pepitone and Saffioti found that adults explain events like these using six primary types of non-material explanations: Fate, God, luck, chance, just reward, and just punishment.

The objective of the present study is to assess the types of explanations children generate and/or consider plausible when asked to explain a variety of significant events that are not easy to interpret using natural constructs. Our primary question is whether and when children appeal to supernatural forces to explain these types of events. Based on traditional views of development (e.g., Piaget, 1929), we might expect that children become increasingly scientific with age and, thus, appeal more frequently to natural explanations in order to explain such events. Alternatively, more recent perspectives on development indicate a coexistence of natural and supernatural beliefs throughout development. This could suggest that both children and adults use these two different sorts of explanations at similar rates (e.g., Subbotsky, 1993; Legare and Gelman, 2008; Evans et al., 2011).

In addition to documenting adults' consistent use of supernatural explanations, Pepitone and Saffioti (1997) found that adults selectively appealed to particular supernatural explanations based on the characteristics of the events they encountered. For example, fate was often used to explain outcomes that

appeared predestined or “meant to be,” whereas belief in God was used to interpret remarkable outcomes that defied the laws of biology and physics. This specificity is interesting and important, as it indicates that people have specialized belief systems within the supernatural domain as well as within the natural domain. In the event that children do endorse supernatural explanations, it is important to assess whether they exhibit the same specificity that they show in their natural explanations (Hickling and Wellman, 2001) and that adults display in their supernatural reasoning.

A third focus of our research is the extent to which children and adults endorse multiple explanations for the same event. Legare and Gelman (2008) found strong evidence in their sample of both children and adults for the coexistence of multiple explanatory frameworks regarding the causes of disease. The endorsement of multiple explanations has also been documented with regard to magical beliefs (Subbotsky, 2004), understanding of species origination (Evans, 2001; Poling and Evans, 2002), and concepts of death (Harris and Gimenez, 2005; Astuti and Harris, 2008; Rosengren et al., 2009).

What evidence is there that children use supernatural explanations at all? Arguably one of the earliest documentations of such reasoning is Piaget’s work on immanent justice. Piaget (1932) described young children as adhering to the belief that “a fault should automatically bring about its own punishment” (p. 256), and that it is not until the formal operations period that children judge an unfortunate outcome as occurring independently of one’s bad behavior. Although it is not clear how children conceptualize the force that is responsible for this system of punishment, belief in immanent justice does imply belief in something that does not accord with the laws of nature as we know them. More recent research has replicated children’s use of this sort of reasoning for positive events and also documented a similar decline with age in immanent justice reasoning with regard to good behavior and fortunate outcomes (Fein and Stein, 1977; Jose, 1990).

Some researchers have examined the extent to which children employ supernatural explanations for specific concepts, such as illness (Bibace and Walsh, 1981; Springer and Ruckel, 1992; Legare and Gelman, 2008; Evans et al., in press). For example, Legare and Gelman (2008) conducted a study on beliefs about AIDS in a South African community where belief in witchcraft is common. The researchers reported that children of all ages endorsed biological explanations significantly more often than either bewitchment or moral explanations. However many children and adults endorsed both biological and witchcraft explanations, lending support to the idea that natural and supernatural explanations co-exist throughout development.

A number of studies have shown that adults often attribute causality to God for rare, life-altering events (Gorsuch and Smith, 1983; Ritzema and Young, 1983; Spilka and Schmidt, 1983; Pargament and Hahn, 1986). Yet very few studies have examined this process in children. In one study, Wenger (2001) measured the extent to which participants spontaneously referenced God as an explanation for various phenomena. Preschoolers, third graders, and college students were asked questions like, “Why is it that some injuries get better faster than other injuries?” Although God explanations comprised only 16% of the total explanations, results showed that preschoolers produced significantly fewer God explanations than either of the other two age groups, while third graders and college students did not differ significantly in the amount of God explanations they produced. Bering and Parker (2006) found that not until the age of 7 did children explain an unexpected event with reference to the intentions of an unseen agent; this would suggest that explanations that appeal to God or other religious agents might not be present in younger age groups.

Research by Phelps and Woolley (1994) indicates that children often use magic to explain events that both seem impossible and for which they lack explanations. These researchers presented children with physical events that violated their expectations, and asked the children to explain how the events happened. Children between 4 and 8 years of age used magic as an explanation for physical events when adequate physical explanations were not readily apparent. Work by Johnson and Harris (1994) also indicates that, when faced with an impossible outcome, 3- to 7-year-old children often assume that the event must have been caused by magic. Thus it appears that until about age 7 or 8, appeals to magic are made in explaining unusual events. However, Phelps and Woolley’s research also indicates that by the age of 8 most children do not view magic as a real force that operates in the world and instead use the word “magic” to indicate the presence of a trick.

Our study consisted of two parts. The first part examined the explanations children spontaneously generated when asked to account for unexpected events. We asked for spontaneous explanations first, in order to get a sense of what types of explanations, including natural ones, children might be most likely to recruit in everyday life. In the second part, children were provided with three different supernatural explanations for each scenario: (1) moral justice, (2) God, and (3) luck. Ratings of the acceptability of each explanation were then solicited. We used this method because, although we did not expect children to generate spontaneously all of the different kinds of supernatural explanations, we anticipated that they were familiar with and probably had ideas about each one.

Of the six supernatural explanations explored by Pepitone and Saffioti (1997), we chose to include the categories of moral justice (a combination of “just reward” and “just punishment”), God, and luck. Based on prior research, we expected children to understand and appeal to both moral justice and God to explain certain events. Although there is less research on children’s understanding and use of the concept of luck, work on children’s perceived control in school performance shows that children, at times, appeal to luck to account for their academic success and failure (Skinner, 1990). Young children also seem to prefer lucky to unlucky individuals (Olson et al., 2008). We chose not to include the category of magical explanations, as there is very little evidence that children of the ages we included believe it to be anything more than parlor tricks. Because the combined moral justice category was composed of one story with a positive outcome (just reward) and one with a negative outcome (just punishment) we included one positive and one negatively valenced story for each of the other categories as well.

A final focus of our research is the role played by religious background in participants’ use of these different explanations. Religion is clearly a significant provider of supernatural explanations for adults, so we expected that more highly religious participants would be more likely to explain events by referring to God. Effects of religiosity on other types of supernatural explanations, however, remain largely unexplored. There is also limited research on the effects of family religiosity on children’s supernatural explanations. Recent work (Woolley and Cox, 2007; Vaden and Woolley, 2011) indicates that children age 4 to 6 from more highly religious families are more likely to judge religious characters and events as real, and more likely to appeal to God to explain events. It is unclear how family religiosity impacts children’s explanations during the elementary school years, especially how it might impact explanations that appeal to other supernatural constructs like moral justice and luck.

Method

Participants

Sixty-seven children participated: 23 8-year-olds (mean age 8.0; range 90–107 months), 22 10-year-olds (mean age 10.0; range 110–131 months) and 22 12-year-olds (mean age approximately 12.0). Twenty-two undergraduates also participated (mean age 21; range 19–25 years). Forty-four females and 45 males participated. Eighty-six percent of the participants were Caucasian, 7%

were Hispanic and 7% were Asian. Participants were primarily Christian or from Christian families (81%). Undergraduate participants were recruited from the student body at a large southwestern university. The parents of children were contacted by mail and/or telephone.

Materials

Six scenarios involving significant “difficult-to-explain” events (Pepitone and Saffioti, 1997) were developed (see Appendix A). We operationalized “difficult-to-explain” scenarios as significant events that either violated standard expectations or were low probability or both. As in Pepitone and Saffioti (1997), each scenario was designed to prime a different supernatural explanation (moral justice, God, or luck). This allowed us to assess developmental changes in the specificity of supernatural explanations. Two scenarios represented each of the three supernatural categories, one of which resulted in a positive outcome and one in a negative outcome. Three sample explanations were also created for each scenario (see Appendix B), with each explanation representing one of the three supernatural categories. A photograph of a man or woman accompanied the presentation of each story.

To provide a sense of the types of stories and explanations we included, the positive moral justice story involved a man, Robert, who did not make much money at his job but spent most of his free time helping sick animals at an animal hospital. Robert unexpectedly received a phone call informing him that he had won a large sum of money in a contest. The three explanations we offered for why Robert won the money were: (1) Because Robert was a nice guy (Moral justice), (2) God must have wanted him to have the money (God), and (3) Robert must have been a lucky person (Luck).

Religiosity questionnaires (see Appendices C and D) were used to evaluate the participant’s religious affiliation (for adults) or that of their family (for children). The questionnaire asked participants to rate both the amount and intensity of their religious involvement. Parents filled out the form for their children, and undergraduates completed the form themselves.

Procedure

Children. Two random orders of the scenarios were created; half of the participants received one and half the other. Children were seated in a chair at a table and told that they were going to hear some stories about some people. The researcher then showed children a photograph of a person and read aloud one of the scenarios. After each scenario had been read, the children were asked to provide a verbal explanation for why they thought the event occurred. This process was repeated for each of the six scenarios.

Children then rated three explanations for each scenario. The three explanations were presented in a different random order for each scenario. The researcher told children that they would hear some explanations that some other children had given for the stories. Children were asked to rate the plausibility of each explanation using a “thumb technique”. Pointing their thumb straight up indicated that they “strongly agreed” with the explanation (coded as 4), pointing it up at a 45° angle indicated that they “agreed a little” (coded as 3), pointing it down at a 45° angle indicated that they “disagreed a little” (coded as 2), and their thumb pointed straight down indicated that they “strongly disagreed” (coded as 1). This process was repeated for all six scenarios. After children had completed the task, they were debriefed and given a reward for participating.

Adults. Undergraduate student participants were approached in one of the main malls on the university campus. They were asked if they would like to participate in a brief psychology-related study. If they agreed, they were taken to a quiet place where they provided informed consent and were then given a written copy of the six scenarios. They were asked to read the scenarios and write their best explanation for each event in the space provided. Participants were then asked to rate the three supernatural explanations as they pertained to each scenario on a scale of 1 (strongly disagree) to 4 (strongly agree). After they had rated the explanations, they completed the religiosity questionnaire. Upon completion of the questionnaire, they were debriefed and thanked for their time.

Coding. Responses were placed into one of five categories, which were developed based on a sample of children’s and adults’ responses: (1) don’t know/no answer, (2) natural, (3) moral justice, (4) God, and (5) supernatural miscellaneous. Natural explanations appealed to aspects of naïve theories of biology, psychology, or physics. For example, in response to the scenario in which a nice man hears he has won a prize, one child responded, “Maybe a kid called and they were just tricking him.” Moral justice responses referenced the valence of the character’s action, as in “Because [Robert] was being really nice to the animals and caring more about other people instead of himself.” God explanations included reference to the intervention and/or involvement of God. One adult responded, for example, that, “God has his reasons.” We created a supernatural miscellaneous category because participants provided a variety of unanticipated supernatural explanations in addition to appeals to luck (which were not numerous enough to constitute a separate category). For example, one participant referred to “wanting” or “needing” something as an explanation (e.g., “Robert needed the money more”) and another claimed that the

story character was being taught that “the grass is not always greener on the other side.”

Results

We begin by discussing the patterns obtained in participants’ spontaneous explanations for the events, focusing first on general patterns, and then exploring patterns within supernatural explanations. We then turn to the question of how participants rated the different types of explanations. For both types of task, we address two additional issues: (1) the level of specificity present in participants’ supernatural explanations (i.e., the extent to which participants provided or endorsed the explanation that was primed), and (2) the effects of emotional valence on explanations. Next we address the extent to which participants endorsed multiple explanations for the events. We conclude by addressing the effects of religiosity on both the provision of spontaneous explanations and the endorsement of various types of explanations.

Spontaneous Explanations

Natural versus Supernatural Explanations. Two research assistants independently coded the replies made by 75% of the sample; inter-rater agreement was 0.90 as calculated by Cohen’s kappa. Our first analysis examined global use of natural versus supernatural explanations across the different age groups. The number of natural and supernatural explanations each participant used was averaged across each age group, with a range from 0 to 6 corresponding to the number of stories. The general category of supernatural explanations included all responses that were coded as moral justice, God, or supernatural miscellaneous. Figure 1 shows that, overall, participants were more likely to use natural than supernatural explanations to explain these events. The figure also shows that this difference is particularly apparent in the youngest two age groups. These younger children often appeared driven toward finding a natural explanation, even for scenarios that adults seamlessly explained via supernatural reasoning. For example, one 10-year-old responded that the woman had suddenly recovered from a fatal illness, “because, um, she slept a lot, and it helped cancer” and for the athletic woman who tripped on her wedding day, “because she tripped over a rock while she was walking. People usually trip over stuff and fall.” A 2 (explanation type: natural, supernatural) × 4 (age group: 8-year-old, 10-year-old, 12-year-old, adult) ANOVA confirmed these impressions. The analysis revealed a main effect of explanation type, $F(1,85)=51.18$, $p<0.001$, $\eta_p^2=0.38$, with use of natural explanations significantly higher

($M=4.0$, $SE=0.16$) than supernatural explanations ($M=1.82$, $SE=0.15$). This effect was qualified by a significant interaction between age group and explanation type, $F(3, 85)=5.83$, $p<0.001$, $\eta_p^2=0.17$.

Simple effects analyses were conducted to explore the interaction between age and explanation type. As shown in Figure 1, children in all three age groups used natural explanations more than supernatural explanations ($t(22)=6.52$, $p<0.01$ for 8-year-olds; $t(21)=6.97$, $p<0.01$ for 10-year-olds; $t(21)=2.47$, $p<0.05$ for 12-year-olds) whereas adults used the two types of explanations approximately equally. Additional analyses of the number of natural explanations revealed that the 8- and the 10-year-olds differed significantly from the adults (post-hoc Bonferroni tests, $p<0.05$), whereas the 12-year-olds did not. Analyses of the supernatural explanations indicated that, again, the 12-year-old group was intermediate between the younger children and the adults, with both 8- and 10-year-olds differing significantly from adults (Bonferroni, p values <0.01) but no other differences.

Supernatural Explanations. It is clear from these analyses that natural explanations are the most common in children of all three age groups, but that use of supernatural explanations increases with age. We next explored potential age differences in the use of specific supernatural explanations along with the relative frequency of each type of supernatural explanation at each age. Although supernatural responses were infrequent, a significant majority of participants at each age used at least one supernatural explanation during the course of the study (65% of 8-year-olds, 73% of 10-year-olds, 86% of 12-year-olds and 91% of adults). As shown in Table 1, moral justice appears to be the primary supernatural explanation used by the youngest children (8- and 10-year-olds). A typical response was given by a 10-year-old, who explained a man winning a contest by saying that it was “because he helped the animals at the animal shelter.” At age 12, use of God explanations appeared to increase. Adults, on the other hand, appeared to have a variety of miscellaneous supernatural explanations that they brought to bear on these events, including explanations like, “it was a sign.”

A 4 (age) \times 3 (supernatural explanation type: moral justice, God, supernatural miscellaneous) ANOVA on the number of spontaneous supernatural explanations confirmed these impressions and revealed a significant interaction between age and explanation type, $F(6, 170)=2.94$, $p<0.01$, $\eta_p^2=0.89$. Simple effects analyses were conducted separately for each age group and for each explanation type. These analyses revealed no differences in the relative frequencies of use of the three different supernatural explanation types in the 8-year-olds. Pairwise comparisons ($p<0.05$) indicated that the 10-year-olds

used moral justice explanations ($M=0.64$, $SD=0.66$) significantly more than supernatural miscellaneous explanations ($M=0.18$, $SD=0.50$), as did 12-year-olds ($M=0.91$, $SD=0.87$ for moral justice and $M=0.36$, $SD=0.66$ for supernatural miscellaneous). The patterns were different for adults; they were significantly more likely to use miscellaneous supernatural responses ($M=1.41$, $SD=1.41$) than God responses ($M=0.50$, $SD=0.86$). Indeed, analyses of age differences in the use of the supernatural miscellaneous category indicated that adults were significantly more likely to use this category of explanation than were children of any age group (Bonferroni post-hoc comparisons, all $p<0.01$). Similar analyses of the God explanations indicated that both adults and the 12-year-olds were significantly more likely to use God to explain events than were the two younger age groups (both $p<0.01$). Finally, analysis of the use of moral justice explanations across age groups revealed no differences; all age groups used this type of explanation with equal frequency.

Analyses of the specific supernatural explanations given for each type of story (moral justice, God, luck) address the question of specificity. Table 1 indicates that there is age-independent specificity for moral justice stories, but developmental increases in specificity for both God and luck stories. Confirming this statistically, for the moral justice stories, a 4 (age) \times 3 (explanation type) ANOVA revealed a significant effect of explanation type on responses, $F(2, 170)=29.53$, $p<0.001$, $\eta_p^2=0.26$. Pairwise comparisons ($p<0.001$) indicated that for the moral justice stories, participants of all ages gave significantly more moral justice responses ($M=0.76$ (out of 2), $SD=0.76$) than either God ($M=0.15$, $SD=0.47$) or supernatural miscellaneous responses ($M=0.15$, $SD=0.39$).

For the God stories, ANOVA similarly revealed a significant effect of explanation type, $F(2, 170)=10.78$, $p<0.001$, $\eta_p^2=0.11$, qualified by a significant interaction between age and explanation type, $F(6, 170)=2.54$, $p<0.05$, $\eta_p^2=0.09$. Although both 8- and 10-year-olds almost never used God explanations, simple effects ANOVA on 12-year-olds' responses revealed a main effect of explanation type, $F(2, 42)=5.62$, $p<0.01$, $\eta_p^2=0.21$. Follow-up t -tests indicated that 12-year-olds used God explanations for God stories ($M=0.46$, $SD=0.67$) more often than they used moral justice explanations ($M=0$), $t(21)=3.18$, $p<0.005$, and that there was a trend toward using God explanations more than supernatural miscellaneous ones ($M=0.14$, $SD=0.35$), $t(21)=1.18$, $p=0.09$. Simple effects ANOVA on adults' responses also revealed a main effect of explanation type, $F(2, 42)=3.94$, $p<0.05$, $\eta_p^2=0.16$. Follow-up t -tests indicated that adults used God explanations for God stories ($M=0.36$, $SD=0.12$) more often than they used moral justice explanations ($M=0$), $t(21)=2.94$, $p<0.01$, but not more than supernatural miscellaneous ones

($M=0.41$, $SD=0.13$). Finally, analysis of the luck stories also revealed a significant effect of explanation type, $F(2, 170)=9.64$, $p<0.001$, $\eta_p^2=0.10$, qualified by a significant interaction with age, $F(6, 170)=6.27$, $p<0.001$, $\eta_p^2=0.18$. Pairwise comparisons ($p<0.05$) indicated that only in the adult group were miscellaneous supernatural explanations ($M=0.64$, $SD=0.79$) used with more frequency for these stories than moral justice ($M=0$, $t(21)=3.78$, $p<0.001$) or God explanations ($M=0.05$, $SD=0.21$, $t(21)=3.25$, $p<0.005$).

Emotional valence. We also examined whether the valence of the story outcome affected the type of explanation offered. A 4 (age) \times 2 (outcome valence: positive, negative) ANOVA on the provision of natural explanations revealed that participants provided natural explanations more frequently for stories with negative (e.g., a man crashes his car; $M=2.20$ (out of 3), $SD=0.09$) versus positive (e.g., a man finds money; $M=1.79$, $SD=0.10$) outcomes, $F(1, 85)=15.17$, $p<0.05$, $\eta_p^2=0.15$. Conversely, participants provided supernatural explanations (all three sub-types combined) more frequently for stories with positive ($M=1.12$, $SD=0.09$) versus negative ($M=0.70$, $SD=0.08$) outcomes, $F(1, 85)=20.59$, $p<0.001$, $\eta_p^2=0.20$. This effect was qualified by a significant interaction indicating that the effect was found in all age groups except the 8-year-olds, $F(3, 85)=5.23$, $p<0.002$, $\eta_p^2=0.16$.

Explanation Ratings

We next examined how participants judged supernatural explanations that fictitious others had purportedly given for the events. We reasoned that, even though children might not often spontaneously generate these explanations, they might recognize and be receptive to them. Examination of the ratings indicated a clear preference for certain types of explanations for certain events. A 4 (age) \times 3 (explanation-type) ANOVA was first conducted on ratings of explanations for the moral justice stories. This analysis revealed a significant effect of explanation type, $F(2,170)=7.32$, $p<0.001$, $\eta_p^2=0.08$. Follow-up paired samples t -tests comparing the three types of explanations indicated that moral justice explanations ($M=2.93$, $SD=0.85$) were rated more highly for moral stories than were luck explanations ($M=2.46$, $SD=0.85$; $t(88)=2.04$, $p<0.05$), but moral justice and God ($M=2.75$, $SD=1.00$) explanations were rated similarly. For the God stories, ANOVA revealed a significant effect of explanation type, $F(2, 170)=36.21$, $p<0.001$, $\eta_p^2=0.30$, with participants of all ages rating God explanations ($M=2.82$, $SD=1.02$) higher than both moral justice ($M=1.81$, $SD=0.65$, $t(89)=8.91$, $p<0.001$) and luck ($M=2.18$, $SD=0.80$, $t(89)=4.58$, $p<0.001$) explanations. Finally, for the luck stories, ANOVA

revealed a significant effect of explanation type, $F(2, 170)=25.43$, $p<0.001$, $\eta_p^2=0.23$. Follow-up analyses indicated that luck explanations were rated more highly for luck stories than were both God, $t(88)=2.58$, $p<0.05$, and moral justice explanations, $t(88)=7.34$, $p<0.001$. In summary, participants of all ages exhibited specificity in their ratings of explanations for the different story-types.

We also examined whether participants endorsed each type of explanation differently for positive versus negative outcome stories. A 4 (age) \times 2 (outcome valence: negative, positive) ANOVA on ratings of moral justice explanations indicated that participants endorsed moral justice explanations more highly for positive ($M=2.55$, $SE=0.08$) than for negative ($M=1.78$, $SE=0.05$) outcomes, $F(1, 85)=110.22$, $p<0.001$, $\eta_p^2=0.57$. Participants also endorsed God explanations more highly for positive ($M=2.84$, $SE=0.10$) than for negative outcomes ($M=2.35$, $SE=0.09$), $F(1, 85)=46.04$, $p<0.001$, $\eta_p^2=0.35$. The same was also true for luck explanations, with participants endorsing them more for positive ($M=2.75$, $SE=0.21$) than for negative ($M=2.06$, $SE=2.18$) outcomes, $F(1, 85)=66.38$, $p<0.001$, $\eta_p^2=0.44$.

Endorsement of Multiple Explanations

Next, we explored the extent to which participants endorsed multiple explanations for the same event. Participants were considered to endorse multiple explanations if they rated agreement (either a 3 or 4 on the 4-point scale) with an explanation that differed from the one they spontaneously provided. Every child (i.e., 100% of 8-, 10-, and 12-year-olds) endorsed multiple explanations for at least one of the six events, whereas only 77% of adults did so. A 4 (age) \times 3 (story type) \times 2 (valence) ANOVA was conducted on the number of multiple explanations endorsed. The analysis revealed significant effects of both story type, $F(2, 170)=11.88$, $p<0.001$, $\eta_p^2=0.12$, and emotional valence, $F(1,170)=25.11$, $p<0.001$, $\eta_p^2=0.23$. These effects were qualified by a significant interaction between story type and valence, $F(2,170)=3.76$, $p<0.05$, $\eta_p^2=0.04$, along with a three-way interaction with age, $F(6, 170)=2.32$, $p<0.05$, $\eta_p^2=0.08$.

Follow-up paired sample t -tests indicated that children exhibited a different pattern of responding from adults. For all groups of children, multiple explanations were endorsed at equally high rates for both positive (overall $M=0.88$, $SD=0.33$) and negative moral justice stories ($M=0.90$, $SD=0.31$). However for both God and luck stories, children endorsed multiple explanations significantly more often for positive stories ($M=0.85$, $SD=0.36$ for God and $M=0.85$, $SD=0.36$ for luck) than for negative stories ($M=0.61$, $SD=0.49$ for God and $M=0.55$, $SD=0.50$ for luck; see Appendix E for all means and statis-

tical values). Adults endorsed multiple explanations more for positive moral justices stories ($M=0.77$, $SD=0.43$) than for negative ones ($M=0.55$, $SD=0.51$), but endorsed multiple explanations equally often for positive ($M=0.63$, $SD=0.49$) and negative ($M=0.50$, $SE=0.51$) God stories and for positive ($M=0.50$, $SD=0.51$) and negative ($M=0.55$, $SD=0.51$) luck stories.

Because we presented children with a range of supernatural explanations to rate, we were also able to assess the frequency of endorsing multiple supernatural explanations for the same event. For this analysis we simply tallied the number of children who rated more than one explanation as 4 (strongly agree) or 3 (agree a little). The patterns paralleled those from the previous analysis. For the moral justice stories, for all ages, the majority of participants endorsed multiple explanations, both for positive and negative stories (76% overall). For God stories, the majority of children endorsed multiple explanations for positive stories (67%) but rejected multiple explanations for negative stories (91%). For the luck stories, participants showed the same pattern on the negative stories as with negative God stories, that is, a reluctance to endorse multiple explanations (91%). However the positive luck stories reveal a developmental trend with the majority of 8-year-olds endorsing multiple explanations (91%), about half of the 10- (55%) and 12-year-olds (50%) endorsing multiple explanations, and only a minority of adults willing to do so (14%).

Effects of Religiosity

Spontaneous explanations. Participants were each assigned a religiosity score based on the information they (or their parents) provided on the religiosity questionnaire. The score reflected a percentage of the total number of religious behaviors – as listed on the religiosity form – in which participants engaged, and ranged from 0 to 100%. A median split was performed on the data, resulting in two groups – a high religiosity group ($M=0.74$, $SE=0.03$, $n=41$) and a low religiosity group ($M=0.20$, $SE=0.02$, $n=48$). A 4 (age) \times 2 (religiosity) \times 2 (explanation type: natural, supernatural) ANOVA was conducted to explore general patterns in spontaneous use of natural versus supernatural explanations in the two groups. In addition to the main effect of explanation type and the interaction with age discussed previously, this analysis also revealed a trend toward an interaction between religiosity and explanation type, $F(1, 81)=3.69$, $p=0.058$, $\eta_p^2=0.04$, with the difference between natural and supernatural explanations tending to be greater in the low religiosity group.

The two groups also differed in the specific type of supernatural explanation they were most likely to offer. A 3 (explanation type: moral justice, God, luck) \times 2 (religiosity) \times 4 (age) ANOVA revealed a significant interaction between explanation and religiosity, $F(2,162)=14.14$, $p<0.001$, $\eta_p^2=0.15$. This was

qualified by a 3-way interaction between explanation type, religiosity, and age, $F(6, 162)=3.14$, $p<0.005$, $\eta_p^2=0.10$. Simple effects tests on each age group indicated that, although the means for each age group were in the same direction, the interaction between religiosity and explanation type was only significant for the 12-year-olds, $F(2,40)=11.03$, $p<0.001$, $\eta_p^2=0.36$, and adults, $F(2, 40)=6.63$, $p<0.005$, $\eta_p^2=0.25$. Twelve-year-olds with high religiosity scores offered primarily God explanations ($M=1.82$, $SD=1.67$), whereas those with low religiosity scores provided primarily moral justice ($M=1.27$, $SD=1.00$) explanations. Adults with high religiosity scores also provided primarily God explanations ($M=1.50$, $SD=1.04$), whereas adults with low religiosity scores provided mostly supernatural miscellaneous ones ($M=1.69$, $SD=1.49$). It appears thus, from these data, that family religiosity begins to exert a strong effect on children's explanations around the age of 12, with the supernatural explanations of the 12-year-old participants with high religiosity scores almost exclusively referring to God, and those of the low religiosity 12-year-olds referring almost exclusively to moral justice.

Explanation Ratings. Religiosity also affected how participants judged explanations provided by 'others' for the events. As shown in Fig. 2, high religiosity participants had a clear preference for God explanations, whereas the low religiosity participants appeared to prefer luck explanations to the other two. A 4 (age) \times 2 (religiosity) \times 3 (explanation type: moral justice, God, luck) ANOVA on participants' ratings of the explanations yielded a significant main effect of religiosity, $F(1, 81)=5.93$, $p<0.05$, $\eta_p^2=0.07$, which was qualified by a significant religiosity \times explanation type interaction, $F(2, 162)=30.10$, $p<0.001$, $\eta_p^2=0.27$. Paired t -tests on explanation ratings for the low religiosity group indicated that these participants rated luck explanations ($M=2.61$, $SD=0.65$) more highly than both moral justice explanations ($M=2.06$, $SD=0.61$) $t(47)=4.97$, $p<0.001$, and God explanations ($M=2.17$, $SD=0.77$), $t(47)=3.30$, $p<0.005$. In contrast, participants from the high religiosity group rated God explanations ($M=3.09$, $SD=0.76$) more highly than both luck explanations ($M=2.16$, $SE=0.67$), $t(40)=6.26$, $p<0.001$, and moral justice explanations ($M=2.29$, $SD=0.45$), $t(40)=5.86$, $p<0.001$. Simple effects ANOVAs on each explanation type indicated that both God ($F(1,88)=31.99$, $p<0.001$, $\eta_p^2=0.27$) and moral justice ($F(1, 88)=4.15$, $p<0.05$, $\eta_p^2=0.05$) explanations were rated more highly by high religiosity participants than by low religiosity participants, whereas luck explanations were rated more highly by low religiosity participants ($F(1, 88)=9.94$, $p<0.002$, $\eta_p^2=0.10$).

We also examined whether religiosity interacted with valence in participants' ratings. Three 2 (valence) \times 2 (religiosity) ANOVAs were conducted on

participants' explanation ratings, one for each explanation type (moral justice, God, luck). In addition to the main effects of valence and religiosity already discussed, the analysis on God explanations revealed a significant interaction between valence and religiosity, $F(1,87)=8.81$, $p<0.005$, $\eta_p^2=0.09$, indicating that the difference between positive and negative stories was greater for high religiosity participants. The analysis on moral justice explanations revealed the same interaction, $F(1, 87)=5.91$, $p<0.02$, $\eta_p^2=0.06$. Analyses on ratings of luck explanations did not reveal any differences between high and low religiosity participants.

Discussion

Both children and adults appear driven to provide explanations for why things happen, particularly events that are unusual or unexpected (Gopnik, 1998; Keil, 2006; Wellman, 2011). The scenarios that we presented to participants in this study were constructed to represent events that would be difficult (but not impossible) to explain in natural terms, due to their unexpected nature or low probability. The finding that natural explanations were the primary mode of explanation even in the face of these unusual or unlikely events is striking. Although the events were designed to be difficult to explain in natural terms, participants, particularly children, often went to great lengths to do precisely that. The findings are consistent, however, with other recent research on the use of natural versus supernatural explanations. Legare and Gelman (2008), for example, found that even in South African communities in which witchcraft beliefs are prevalent, participants used primarily biological explanations for the acquisition and transmission of disease. More specifically, Legare and Gelman found that, at all ages except adults, biological explanations were preferred over supernatural ones. This is precisely the pattern observed in our data. The results from our data make it clear that this is not a pattern that is specific to explaining disease. Our story set included one story about disease but represented a wide range of other events from winning money to crashing a car. The age-dependent increase in use of the supernatural in our study appears to be due to two trends: (1) an increase in appeals to God around age 12, and (2) an increase in reference to luck and other unique supernatural forces in adults.

The increase with age in attribution of events to God is consistent with recent findings on children's beliefs about the reality status of events and characters in the Bible (Vaden and Woolley, 2011). Although Vaden and Woolley tested only 4- to 6-year-olds, their findings suggest an increase with

age in beliefs that God plays an important causal role in the world. Wenger (2001) also reports an increase with age in God-based explanations for difficult-to-explain phenomena between 5- and 8-year-olds. The increase with age in supernatural explanations overall supports the view that increased enculturation plays an important explanatory role in the development of such concepts (Mead, 1932). As discussed by Harris and Koenig (2006), much of how children think about the world is determined by their ability to evaluate the testimony of others. Children are exposed to religious concepts by their parents and through religious educational activities. It is not clear how a child's concept of luck develops, however primary sources of information most certainly include media and peers (and most likely also parents). A number of our 9- to 10-year-old participants spontaneously referenced the concept of karma, which may be a concept children encounter from their peers at school, or even from television (as seen on the NBC show "My Name is Earl," popular in recent years). Development in this domain thus clearly involves an increase in supernatural or non-scientific thinking that is a function of widening experiences, both social and educational.

Use of moral justice to explain events did not change with age. This contradicts traditional findings of a general decline in immanent justice reasoning during the elementary school years (e.g., Piaget, 1932). Our findings also do not indicate that there is a reemergence of immanent justice reasoning in adults (Raman and Winer, 2004; Callan et al., 2006). However, our data are similar to those of Jose (1991), who found that age did not significantly predict children's use of immanent justice explanations. Also consistent with Jose is our finding that the spontaneous provision of moral justice explanations was relatively uncommon at all ages, which explains, in part, why we did not find a decrease in such explanations with age. It is also worth noting that our coding scheme may have underestimated the extent to which participants provided moral justice explanations, as this category was not used for explanations in which an agent (e.g., a co-worker or God) administered the reward or punishment.

Our research also revealed different patterns of explanation for events with positive versus negative outcomes. Participants were more likely to provide supernatural explanations and to rate supernatural explanations more highly for positive versus negative outcomes. This finding was quite striking within individual children, even within story types, with numerous children providing an unambiguously supernatural explanation for, say, a positive moral justice story, and yet a natural one for its negative counterpart. This may be partly due to the fact that, in the Christian religious traditions from which most of our participants hailed, God is conceptualized as benevolent (see Pargament and Hahn, 1986; Lupfer et al., 1996 for evidence of this pattern in adults, but

see also Gray and Wegner (2009) for the opposite perspective). This explanation is supported by our finding that the valence difference for both God and moral justice explanation ratings was greater for high religiosity participants than for low religiosity participants. Although positive luck explanations were also rated higher than negative luck explanations, there was no difference due to religiosity for the luck explanations.

Pepitone and Saffioti (1997) demonstrated that adults are often quite specific in their use of supernatural explanations; certain types of events elicit appeals to God, for example, whereas other types of events are explained with reference to luck. Johnson (2000) suggests that development includes acquiring ideas about what kinds of explanations are suitable for what kinds of problems, and that adult belief systems may serve very select purposes. Children have been shown to be highly specific in their use of natural explanations (Hickling and Wellman, 2001). It seemed conceivable that, given limited knowledge of supernatural phenomena, children might initially be indiscriminant in their use of these explanations. Our results revealed development in specificity with regard to children's spontaneous explanations, consistent with Johnson's predictions. However, both children and adults exhibited specificity in their ratings of explanations, with the exception that moral justice and God explanations appeared to be linked, and hence considered equally good for moral justice stories. In this case, participants may link these two types of explanations in one causal chain, with God serving as a distal cause and moral justice as a proximal cause (Legare and Gelman, 2008). Thus, specificity of explanations did seem to develop regarding what children spontaneously generated in response to these scenarios, however, even the youngest children, when supplied a range of potential explanations, seemed to have some sense of which ones were best suited to which problems. This suggests a fairly precocious facility with a body of explanatory constructs that is still newly developing and complements Hickling and Wellman's findings with regard to natural explanations.

Some have proposed that supernatural explanations are provided only when natural causes cannot sufficiently explain an event. This type of proposal has been evaluated specifically with regard to explanations that reference God (e.g., the "God of the gaps" theory, see Lupfer et al., 1996). However Lupfer et al. (1992) found that attempts to prime religious reasoning, which they expected would decrease natural explanations, was ineffective, suggesting that both types of explanations coexist. Follow-up work by Lupfer et al. (1996) indicated that adults who considered God a likely explanation for an event also rated natural explanations equally likely, suggesting that the "God of the gaps" theory is inaccurate. Because we do not have ratings of natural explanations, we cannot assess this precise prediction. However, in our data,

God explanations were accepted fairly frequently by participants, including children, who had initially provided natural explanations for the events, casting additional doubt on these sorts of proposals (see also Legare and Gelman, 2008).

In fact, our data revealed a very high level of endorsement of multiple explanations. The proposal that both children and adults often hold multiple, potentially contradictory belief systems was originally endorsed most strongly by Subbotsky (1993) in his studies of children's and adults' magical thinking. Recently, this viewpoint has been revisited by others and extended to a wider range of domains (Nemeroff and Rozin, 1994; Legare and Gelman, 2008; Evans et al., 2011). These researchers argue against a "replacement" view in which irrational, magical, or superstitious thought in childhood is replaced with rational thought in adults. They argue instead that magical or supernatural and scientific beliefs coexist and can be triggered by a variety of different factors. One of these may be the type of task involved. Bibace et al. (1999) propose that less mature forms of reasoning will be apparent in tasks that require spontaneous explanations, and that presenting children with different kinds of explanations from which to choose will produce more sophisticated reasoning. If we consider greater sophistication to reflect stronger adherence to the tenets of adult members of the culture, then our data confirm this pattern (Mead, 1932). However if we consider it to reflect adherence to natural principles, then our data are contradictory to it. An important question for future research is how these explanations are synthesized within the individual. One explanation may be proximal and the other distal, they may be interwoven, or they may even be entirely orthogonal with the participant being agnostic about which is better (Legare and Gelman, 2008).

Our data also revealed an effect of religiosity on the provision and endorsement of supernatural explanations. Numerous studies have attempted to address relations between religiosity and endorsement of a variety of non-natural beliefs, with mixed results. Correlational studies have failed to uncover significant relations between religious and paranormal beliefs in adults (e.g., Rice, 2003). With regard to explaining events, Lupfer et al. (1992) reported that conservative Christians were more likely to explain events with reference to God than were moderate or less religious Christians. Wenger (2001) similarly found that both children and adults with higher levels of religiosity more often attributed causality to God than did those with lower religiosity. In the present study, both highly and less religious participants provided more natural than supernatural explanations spontaneously. However, the groups differed in their use of the different types of supernatural explanations, with

highly religious participants most often offering both God and moral justice as explanations for events, and less religious participants most often explaining events in terms of moral justice and a variety of other supernatural forces, and less often in terms of God. Highly religious participants also rated God explanations highest whereas less religious participants rated luck explanations highest. Our results suggest a significant strengthening of these relations beginning at about age 12.

In conclusion, the data from this study capture a strong propensity in young children to appeal to natural forces in explaining events, even when those events are the type that often elicit supernatural reasoning in adults. Our findings also indicate that, with age, appeal to supernatural forces, particularly God and luck, increases, as does the specificity of children's explanations. These increases provide support for the importance of studying the role of testimony in the formation of children's beliefs (Harris and Koenig, 2006), as it is through such testimony that children acquire the unique explanatory systems of their culture. Across age groups, appeal to multiple explanatory systems was common, supporting a co-existence framework (Subbotsky, 1993; Nemeroff and Rozin, 1994; Legare and Gelman, 2008; Evans et al., in press). Future research should seek to address further the finding that supernatural explanations were more often offered and endorsed for positive than for negative events. Although our data do not allow us to suggest any explanations with confidence, this may be tied to feelings of control, in that people may not want to believe that negative events can be caused by forces outside of their control, and would rather believe that people cause their own problems; this may serve to make people feel safer from negative outcomes (Kay et al., 2009). Religion and other cultural belief systems clearly affect how these patterns of explanation develop; future studies should seek to further elucidate the nature of these mechanisms as well, and to explore these questions in a wider range of religious and cultural backgrounds.

Acknowledgements

This research was funded in part by NICHD grant HD-30300 to Jacqueline D. Woolley. The authors are grateful to Cristine Legare for insightful and constructive comments. We would like to thank the following students who assisted with data collection: Alicia Jones, Carol Leung, Oshma Raj and Amanda Rhoads.

References

- Adler, B. and Fresco, M. (2006). O karma, where art thou [Television series episode]. In G. Garcia (Executive producer), *My Name is Earl*. National Broadcasting Company, New York, NY.
- Astuti, R. and Harris, P. L. (2008). Understanding mortality and the life of the ancestors in rural Madagascar. *Cognitive Science* 32, 713-740.
- Bering, J. M. and Parker, B. D. (2006). Children's attributions of intentions to an invisible agent. *Developmental Psychology* 42, 253-262.
- Bibace, R. and Walsh, M. E. (1981). Children's conceptions of illness. In Bibace, R. and Walsh, M. E. (Eds), *New directions for child development: Children's conceptions of health, illness, and bodily functions*, pp. 31-48. Jossey-Bass, San Francisco, CA.
- Callan, M. J., Ellard, J. H. and Nicol, J. E. (2006). The belief in a just world and immanent justice reasoning in adults. *Personality and Social Psychology Bulletin* 32, 1646-1658.
- Carey, S. (1985). *Conceptual Change in Childhood*. Bradford Books/MIT Press, Cambridge, MA.
- Evans, E. M. (2001). Cognitive and contextual factors in the emergence of diverse belief systems: Creation versus evolution. *Cognitive Psychology* 42, 217-266.
- Evans, E. M., Legare, C. H. and Rosengren, K. S. (2011). Engaging multiple epistemologies: Implications for science education. In Ferrari, M. and Taylor, R. (Eds), *Evolution, epistemology, and science education: Understanding the evolution vs. intelligent design controversy*, pp. 111–139. Routledge, New York, NY.
- Fein, D. and Stein, G. M. (1977). Immanent punishment and reward in six- and nine-year-old children. *Journal of Genetic Psychology*, 131, 91-96.
- Gopnik, A. (1998). Explanation as orgasm. *Minds and Machines* 8, 101-118.
- Gopnik, A. and Schultz, L. (Eds). (2007). *Causal learning: Psychology, philosophy, and computation*. Oxford University Press, New York, NY.
- Gorsuch, R. L. and Smith, C. S. (1983). Attributions of responsibility to God: An interaction of religious beliefs and outcomes. *Journal for the Scientific Study of Religion* 22, 340-352.
- Gray, K. and Wegner, D. M. (2010). Blaming God for our pain: Human suffering and the divine mind. *Personality and Social Psychology Review* 14, 7-16.
- Harris, P. L. and Gimenez, M. (2005). Children's acceptance of conflicting testimony: The case of death. *Journal of Cognition and Culture* 5, 143-164.
- Harris, P. L. and Koenig, M. (2006). Trust in testimony: How children learn about science and religion. *Child Development* 77, 505-524.
- Hickling, A. K. and Wellman, H. M. (2001). The emergence of children's causal explanations and theories: Evidence from everyday conversation. *Developmental Psychology* 37, 668–683.
- Inagaki, K. and Hatano, G. (2006). Young children's conception of the biological world. *Current Directions in Psychological Science* 15, 177-181.
- Johnson, C. N. (2000). Putting different things together: The development of metaphysical thinking. In Rosengren, K. S., Johnson, C. N. and Harris, P. L. (Eds), *Imagining the Impossible*, pp. 179-211. Cambridge University Press, Cambridge.
- Johnson, C. N. and Harris, P. L. (1994). Magic: Special but not excluded. *British Journal of Developmental Psychology* 12, 35-51.
- Jose, P. E. (1990). Just-world reasoning in children's immanent justice judgments. *Child Development* 61, 1024-1033.
- Kay, A. C., Whitson, J. A., Gaucher, D. and Galinsky, A. D. (2009). Compensatory control: Achieving order through the mind, our institutions, and the heavens. *Current Directions in Psychological Science* 18, 264-268.
- Keil, F. C. (2006). Explanation and understanding. *Annual Review of Psychology*, 57, 227-254.
- Legare, C. H. and Gelman, S. A. (2008). Bewitchment, biology, or both: The co-existence of natural and supernatural explanatory frameworks across development. *Cognitive Science* 32, 607-642.

- Legare, C. H., Wellman, H. M. and Gelman, S. A. (2009). Evidence for an explanation advantage in naïve biological reasoning. *Cognitive Psychology* 58, 177-194.
- Lupfer, M. B., Brock, K. F., DePaola, S. J. (1992). The use of secular and religious attributions to explain everyday behavior. *Journal for the Scientific Study of Religion* 31, 486-503.
- Lupfer, M. B., Tolliver, D. and Jackson, M. (1996). Explaining lifer-altering occurrences: A test of the 'God-of-the-gaps' hypothesis. *Journal for the Scientific Study of Religion* 35, 379-391.
- Mead, M. (1932). An investigation of the thought of primitive children, with special reference to animism. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 62, 173-190.
- Nemeroff, C. and Rozin, P. (1994). The contagion concept in adult thinking in the United States: Transmission of germs and of interpersonal influence. *Ethos* 22, 158-186.
- Olson, K. R., Dunham, Y., Dweck, C. S., Spelke, E. S. and Banaji, M. R. (2008). Judgments of the lucky across development and culture. *Journal of Personality and Social Psychology* 94, 757-776.
- Pargament, K. I. and Hahn, J. (1986). God and the just world: Casual and coping attributions to God in health situations. *Journal for the Scientific Study of Religion* 25, 193-207.
- Pepitone, A. and Saffioti, L. (1997). The selectivity of nonmaterial beliefs in interpreting life events. *European Journal of Social Psychology* 27, 23-35.
- Phelps, K. E. and Woolley, J. D. (1994). The form and function of young children's magical beliefs. *Developmental Psychology* 30, 385-394.
- Piaget, J. (1929). *The child's conception of the world*. Routledge and Kegan Paul, London.
- . (1932). *The moral judgment of the child*. Routledge and Kegan Paul, London.
- Poling, D. A. and Evans, E. M. (2002). Why do birds of a feather flock together? Developmental change in the use of multiple explanations: Intention, teleology, essentialism. *British Journal of Developmental Psychology* 20, 89-112.
- Raman, L. and Winer, G. A. (2004). Evidence of more immanent justice responding in adults than children: A challenge to traditional developmental theories. *British Journal of Developmental Psychology* 22, 255-274.
- Rice, T. W. (2003). Believe it or not: Religious and other paranormal beliefs in the U.S. *Journal for the Scientific Study of Religion* 42, 95-106.
- Ritzema, R. J. and Young, C. (1983). Casual schemata and the attribution of supernatural causality. *Journal of Psychology and Theology* 11, 36-43.
- Rosengren, K. S. and Hickling, A. K. (1994). Seeing is believing: Children's explanations of commonplace, magical, and extraordinary transformations. *Child Development* 65, 1605-1626.
- Rosengren, K. S., Miller, P. J., Gutiérrez, I. T., Chow, P., Schein, S. and Anderson, K. A. (2009). *Children's understanding of death: Toward a contextual perspective*. Paper presented at the meeting for the Society for Research in Child Development, Denver, CO.
- Skinner, E. A. (1990). Age differences in the dimensions of perceived control during middle childhood: Implications for developmental conceptualizations and research. *Child Development* 61, 1882-1890.
- Spelke, E. S. and Kinzler, K. D. (2007). Core knowledge. *Developmental Science* 10, 89-96.
- Spilka, B. and Schmidt, G. (1983). General attribution theory for the psychology of religion: The influence of event-character on attributions to God. *Journal for the Scientific Study of Religion* 22, 326-339.
- Springer, K. and Ruckel, J. (1992). Early beliefs about the cause of illness: Evidence against immanent justice. *Cognitive Development* 7, 429-443.
- Subbotsky, E. (1993). *Foundations of the mind: Children's understanding of reality*. Harvard University Press, Cambridge, MA.
- . (2004). Magical thinking in judgments of causation: Can anomalous phenomena affect ontological causal beliefs in children and adults? *British Journal of Developmental Psychology* 22, 123-152.

- Vaden, V. C. and Woolley, J. D. (2011). Does God make it real? Children's belief in religious stories from the Judeo-Christian tradition. *Child Development* 82, 1120–1135.
- Wellman, H. M. (2011) Reinvigorating explanations for the study of early cognitive development. *Child Development Perspectives*, 5, 33–38.
- Wellman, H. M. and Gelman. S. A. (1992). Cognitive development: Foundational theories of core domains. *Annual Review of Psychology* 43, 337-375.
- Wenger, J. L. (2001). Children's theories of God: Explanations for difficult-to-explain phenomena. *Journal of Genetic Psychology*, 162, 41-55.
- Woolley, J. D. and Cox, V. (2007). Development of beliefs about storybook reality. *Developmental Science* 10, 681-693.

Appendix A: Stories

Moral Justice Stories

Positive. Robert lives in Houston with his brother Mike. Robert works hard, but he does not have much money. Every weekend Robert spends his free time taking care of sick animals at the animal hospital. He helps the animals and doesn't get paid, but he loves helping them anyway. One day, Robert was sitting at home when he got a phone call. The man on the phone said that Robert had won \$1,000,000 in a contest. Robert was surprised because he did not even remember entering a contest. He was also very excited because he really needed money. Robert went to tell his brother Mike that he had won the prize. Mike said that he was happy for Robert, but in his head, Mike was thinking, "Why did Robert win a prize and not me?"

Negative. Steven lives close to Dallas where he works for a big company. Steven's job is to take care of the company's money. After work, Steven likes to take his car and go racing. Steven knows that racing his car is illegal, but he thinks it is really fun. Steven is a very good driver – he is really good at steering around sharp curves – but he normally loses his races because he does not have a very fast car. So one day Steven decided that he needed a new car. Steven decided to steal a little bit of money from his work each day until he had enough money to buy a car. After a few months, Steven stole enough money to buy a really fast car. Right after Steven bought his new car, he took it racing. But, during his very first race, Steven crashed his car into a tree. Steven was not hurt, but his new car was ruined. Steven thought to himself, "How could this happen?"

God Stories

Positive. Veronica lives in Austin with her husband and daughter. About two years ago, Veronica became very sick with cancer. Because of the cancer, Veronica had to quit her job, so she did not have enough money to buy medicine. Veronica became very sad because she thought she would never get better. Then one day, Veronica woke up and she did not feel sick anymore. She went to the doctor and the doctor told her that her cancer had gone away. Veronica asked the doctor, "How did the cancer go away?" The doctor said that he did not know.

Negative. Sarah lives in a city in west Texas that is very close to the desert. It almost never rains in Sarah's city, so everyone has to be careful when they use water. But one day, all of a sudden it started raining really hard in Sarah's city. It rained and rained for almost a week. At first, Sarah was happy that it was raining so much. But, after a while, Sarah thought that it was raining too much. Sarah started wishing that it would stop raining because she noticed that the streets were starting to

flood. It rained so much that Sarah's whole neighborhood flooded and everyone's houses filled with water. Sarah wondered why it rained so much in a city where it almost never rains.

Luck Stories

Positive. A few years ago, Jorge moved to Austin because he loved the parks around the city. Jorge is a very good hiker and he goes hiking every weekend. But, one weekend, Jorge went hiking and he got lost. Jorge tried to find his way back home, but he could not. When Jorge did not come home, his wife called the police. The police looked and looked for Jorge, but they could not find him. Jorge was lost in the woods for 3 days. Then, on the third day, Jorge saw a man taking a walk through the woods. The man was not even looking for Jorge, but he had found him. When the man saw Jorge, he took him home to his wife. When Jorge got home, he wondered, "How did this man find me when the police could not even find me?"

Negative. Carol lives in an apartment in San Antonio. Carol loves to run for exercise. So, each morning she gets up really early to go for a jog. Sometimes Carol even runs in races. She is a very good runner. A few months ago, Carol was supposed to get married. But on the day of her wedding, she had an accident. While Carol was walking to the church, she tripped and hurt her leg. Carol's leg was hurt badly so she had to be taken to the hospital and she missed her wedding. Carol was sad because she missed her wedding and because she knew she wouldn't be able to run in any more races for a long time. Carol wondered to herself, "How could this happen?"

Appendix B: Explanations

Moral Justice Positive (Robert)

Moral Justice (MJ): Because Robert was a nice guy.
God (G): God must have wanted him to have the money.
Luck (L): Robert must have been a lucky person.

Moral Justice Negative (Steven)

MJ: Because Steven did bad things.
G: God was punishing Steven.
L: Because Steven was really unlucky.

God Positive (Veronica)

MJ: Veronica was a nice woman.
G: Because God caused a miracle to happen.
L: Because Veronica was a really lucky lady.

God Negative (Sarah)

MJ: Because Sarah was a mean person.
G: God must have wanted the rain to come.
L: Sarah was an unlucky person

Luck Positive (Jorge)

MJ: Jorge was a nice man.
G: God sent him there to save Jorge.
L: Jorge was a really lucky guy.

Luck Negative (Carol)

MJ: Because Carol was not a good person.

G: God did not want her to get married.

L: Carol had really bad luck.

Appendix C: Adult Religiosity Questionnaire

In this study you were asked about your supernatural beliefs. We would like to know whether religious background affects your understanding of the supernatural. To help us assess that, we would like you to provide us with some information about your religious affiliation and related activities. Your responses to this questionnaire are voluntary and will be kept confidential.

1. Do you have a religious affiliation? Yes No
 - 1a If so, what is your religious affiliation?
2. (If you said *yes* to No. 1) How would you classify your level of involvement with your religion? Very Active Moderately Active Inactive
3. (If you said *yes* to No. 1) If you are active, what sort of religious activities do you engage in?
At home:
In your place of worship:
4. How involved are you in religious activities? Very strongly Moderately Not at all
5. Please list any religious activities in which you participate
At home:
At your place of worship:
6. How often would you say you engage in the sorts of activities you listed above?
Frequently Sometimes Infrequently
(more than 5 times /week) (1-5 times /week) (less than once /week)

Appendix D: Parent Religiosity Questionnaire

Note to parents: Children in this study will be asked about their supernatural beliefs. We would like to know whether religious background affects how children understand the supernatural. To help us assess that, we would like you to provide us with some information about your religious affiliation and related activities. Your responses to this questionnaire are voluntary and will be kept confidential.

1. Do you have a religious affiliation? Yes No
 - 1a. If so, what is your religious affiliation?
2. (If you said *yes* to No. 1) How would you classify your level of involvement with your religion? Very Active Moderately Active Inactive
3. (If you said *yes* to No. 1) If you are active, what sort of religious activities do you engage in?
At home:
In your place of worship:
4. Do you talk with your child about religion? Yes No
- 4a. If so, how often do you and your child talk about religion?
Frequently Sometimes Infrequently
(more than 5 times /week) (1-5 times /week) (less than once /week)

Table 1 (cont.)

| Explanation type | Story type | | |
|----------------------------|---------------|------|------|
| | Moral Justice | God | Luck |
| Supernatural miscellaneous | | | |
| 8 years | 0.04 | 0.30 | 0.00 |
| 10 years | 0.14 | 0.00 | 0.05 |
| 12 years | 0.05 | 0.14 | 0.18 |
| Adult | 0.36 | 0.41 | 0.64 |
| Total | 0.15 | 0.21 | 0.21 |

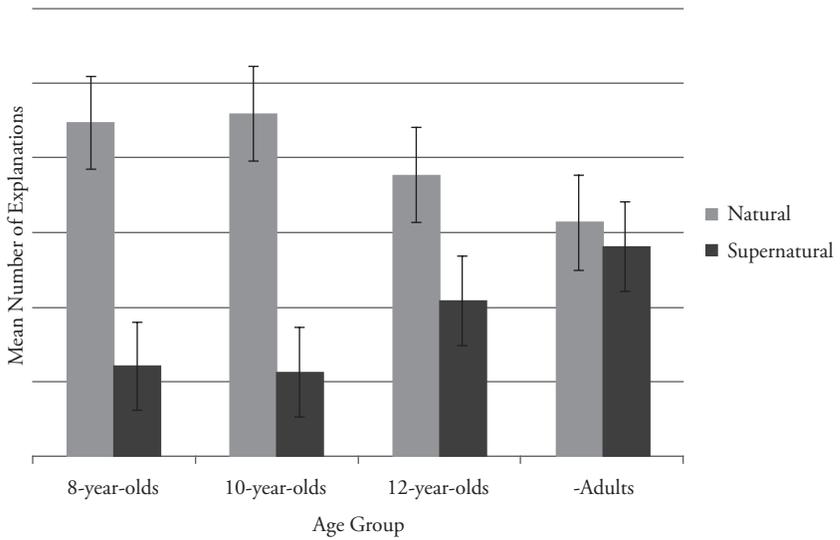


Figure 1. Mean spontaneous response number for each age group by explanation type. Error bars are 95% confidence intervals.

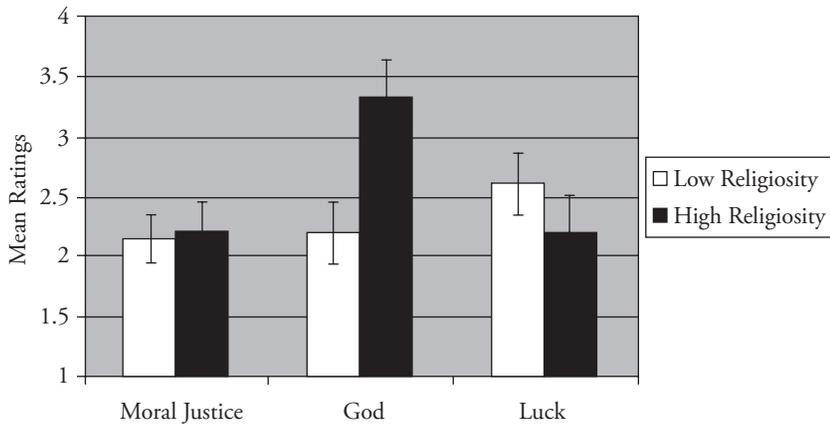


Figure 2. Mean response ratings for each supernatural explanation type by religiosity group. Error bars are 95% confidence intervals.

