



# Miraculous, magical, or mundane? The development of beliefs about stories with divine, magical, or realistic causation

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## Abstract

Children's naïve theories about causal regularities enable them to differentiate factual narratives describing real events and characters from fictional narratives describing made-up events and characters (Corriveau, Kim, Schwalen, & Harris, *Cognition* 113 (2): 213–225, 2009). But what happens when children are consistently presented with accounts of miraculous and causally impossible events as real occurrences? Previous research has shown that preschoolers with consistent exposure to religious teaching tend to systematically judge characters involved in fantastical or religious events as real (Corriveau et al., *Cognitive Science*, 39 (2), 353–382, 2015; Davoodi et al., *Developmental Psychology*, 52 (2), 221, 2016). In the current study, we extended this line of work by asking about the scope of the impact of religious exposure on children's reality judgments. Specifically, we asked whether this effect is domain-general or domain-specific. We tested children in Iran, where regular exposure to uniform religious beliefs might influence children's reasoning about possibility in non-religious domains, in addition to the domain of religion. Children with no or minimal schooling (5- to 6-year-olds) and older elementary school students (9- to 10-year-olds) judged the reality status of different kinds of stories, notably realistic, unusual (but nonetheless realistic), religious, and magical stories. We found that while younger children were not systematic in their judgments, older children often judged religious stories as real but rarely judged magical stories as real. This developmental pattern suggests that the impact of religious exposure on children's reality judgments does not extend beyond their reasoning about divine intervention. Children's justifications for their reality judgments provided further support for this domain-specific influence of religious teaching.

**Keywords** Testimony · Possibility · Religion · Community Consensus · Reality

## Introduction

Although many English-speaking adults are familiar with Robin Hood, they may be uncertain about his ontological status. Did Robin Hood, a character presented in ballads as early as 1450, really exist? How do adults reason about whether he is real or not, based on the kinds of things he did and the extraordinary abilities he was rumored to have? For adults, arriving at answers to these questions may simply be a matter of consulting historical accounts, commentaries, essays, and stories about the outlaw. But how do children conclude that some characters they encounter in stories and media, like Harry Potter, are only pretend and some, like Rosa Parks, are real?

Studies of children's ability to distinguish between historical and fantastical characters suggest that between the ages of 3 and 5 years, children begin to make use of contextual cues in stories to determine the status of an unfamiliar character (Corriveau et al., 2009; Woolley & Cox,

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2007). Specifically, these cues tend to either align with or violate children's early developing intuitions about physical, biological, and mental causal regularities (Subbotsky, 1994; Woolley & Van Reet, 2006). For example, children judge that the characters in fairy tales are fictional and not historical, given the causal violations typically included in such stories (e.g., characters flying, conjuring items from thin air, or being able to read others' minds). Nevertheless, among preschoolers in the USA, compared to children with minimal exposure to religion, children who are regularly exposed to religious teaching are more likely to judge characters embedded in stories with fantastical elements (e.g., a man eating an apple that keeps him alive forever) as real (Corriveau et al., 2015). Furthermore, among preschoolers in Iran, a religious society, patterns of reality judgments look very similar to preschoolers in the USA, who are regularly exposed to religious teaching (Davoodi et al., 2016).

In the current project, we examine Iranian children's reasoning about story characters and events. We focus on children from Iran because they are consistently exposed to religious teachings from various sources both inside and outside of their immediate home environment. Given this widespread exposure to religion, we entertained two competing hypotheses regarding its influence on children's ontological judgments (i.e., their judgments about the reality status of story characters and story events). The first hypothesis was that the effect of such exposure is domain-general. By contrast, the second hypothesis was that exposure to religious teaching and religious testimony operates only as a domain-specific influence. Both hypotheses predict that with consistent exposure to religion over development, children come to represent accounts of religious miracles and God's extraordinary powers as possible, and accordingly judge *religious* stories including these elements to be real. The hypotheses diverge, however, in their predictions about children's reality judgments of *non-religious* stories, which include either impossible (i.e., *magical* stories) or improbable (i.e., *unusual* stories) elements. The domain-general account assumes a "carry-over" effect of religious exposure; it suggests that with consistent exposure to religious teaching over the course of development, *non-religious* but unrealistic stories should also often be judged as real. By contrast, the domain-specific account predicts that the effect of religious exposure is confined to reasoning about religious contexts. Therefore, *non-religious* but unrealistic stories should rarely be judged as real.

Research on the extent to which religious exposure impacts children's ontological judgments in the USA has produced mixed findings. Some research suggests a domain-general effect. For example, in comparison to children with no reported religious exposure at home or school, 5- to 6-year-old children with religious exposure (either at school, at home, or both) were more likely to judge characters

embedded in either Biblical stories or fantastical, non-Biblical stories as real (Corriveau et al., 2015). However, the difference between religious and non-religious children's judgments was smaller for fantastical characters than for Biblical characters. By implication, religious exposure might have a modest "carry-over" effect, reaching beyond the domain of religion (see also Davoodi et al., 2016, for a similar pattern among Iranian children). Other research, by contrast, indicates a more restricted effect of religious exposure. For example, Payir et al. (2021) presented 5- to 11-year-old children in the USA, attending either parochial (Catholic) or secular schools with fantastical, religious, and realistic stories. Although children from the parochial schools were more likely to judge characters in religious stories as real, they were no more likely than children from the secular schools to judge characters in fantastical stories as real.

In the current study, we explored possible explanations for the discrepancy in findings noted above by examining whether growing up in Iran, a relatively homogenous religious community (as opposed to a more diverse religious community, such as the USA), influences children's understanding of possibility in either a domain-specific or domain-general manner. Importantly, we investigated this question from a developmental perspective by including both younger children who had no, or minimal, experience in primary school (5- to 6-year-olds) and older children who had several years of schooling (9- to 10-year-olds). This developmental approach, together with the decision to study children in Iran, allowed us to examine the impact of cumulative, non-familial exposure to accounts of religious miracles. Specifically, children in Iran are exposed to systematic religious education as an integral part of formal schooling. Below, we provide a more detailed overview of children's exposure to religious instruction in Iran before introducing the specific aims of the current project.

## Religious exposure in Iran

All aspects of public life in contemporary Iran are governed by Shiite religious values. Since the Islamic Revolution over 40 years ago, such governance is exercised by the central Islamic government of Iran (Kazemipour & Rezaei, 2003; Mehran, 2007; Yarshater, 2004). The pervasiveness of Shiite religious values is reflected in people's beliefs and practices at home. For example, the most recently available data on Iranian adults' priorities for raising children indicate that 71% mentioned "religious faith" as an important quality for children to develop (World Values Survey Association, 2005). Although the relevant demographics may have changed slightly in the intervening years, in this survey of 2,667 Iranian adults, 91% self-identified as Shia Muslim, with 8% as Sunni Muslims, and 0.6% reported belonging to no religious denomination. In the sample included in the

current study, 96.1% of parents indicated their religious affiliation as “Islam,” and there was a strong link between parents’ level of religiosity and the importance that they attached to raising their children with a religious outlook (see Payir et al., 2020, for details).

Moreover, children are exposed to a consistent set of religious values outside of the home environment. As children progress through school, their exposure to such teaching becomes even more uniform due to the state-mandated curriculum for all schools, which incorporates lessons from the Koran as well as *Dini* (Religion) lessons. In the context of lessons from the Koran, verses are recited and memorized. *Dini* lessons include teachings about Shiite Islam as well as stories about miracles performed by prophets, including Moses and Jesus (Mehran, 2007). Thus, if cumulative exposure to religion influences the development of the ability to reason not just about miraculous possibilities involving divine causation, but also about fantastical possibilities, then such effects are especially likely to be observed among older Iranian children who have had longer and wider exposure to religious instruction.

## Current project

In the current project, we explored two main questions. First, we asked whether exposure to religious instruction has a domain-specific or domain-general impact on children’s *reality judgments*. We sought to answer this question by comparing children’s judgments of various causally possible stories as compared to causally impossible stories. Specifically, we presented children with two types of causally possible stories: (1) *Realistic* stories in which common occurrences take place and causal regularities are not violated, and (2) *unusual* stories in which causal regularities are not violated but very improbable occurrences take place. We compared children’s judgments of these causally possible stories with two types of causally impossible stories, both involving violations of causal regularities: (1) *Magical* stories in which causal regularities are violated through magic, and (2) *religious* stories in which causal regularities are violated through divine intervention (e.g., God helping a character turn water into apple juice). This allowed us to ask whether, and to what extent, children in a relatively uniform religious society distinguish *religious* stories from other story types. Because previous research suggests that children make similar judgments whether they are asked about a story character or a story event (Corriveau et al., 2009), to check for such consistency, children were asked about either the main *character* or the main *event* in the stories.

If the effects of religious exposure are domain-general, we should observe some “carry-over” effects of religious exposure to children’s reality judgments of other causally impossible story types. For example, because of regular

exposure to stories about miracles from the Koran, children should frequently judge not only *religious* stories, but also *magical* stories, as real. Indeed, granted this domain-general pattern, religious and magical stories should be judged as real at similar rates to stories in which causal regularities are not violated (i.e., realistic and unusual stories, similar to Corriveau et al., 2015; also see Davoodi et al., 2016, for a comparison between fictional and realistic stories). By contrast, if the effect of exposure to accounts of miracles from the Koran is local, and therefore domain-specific, then religious stories should be judged as real more often than magical stories (c.f., Payir et al., 2021). Moreover, if cumulative religious exposure contributes to a view of religious stories as a distinctive type of narrative, we might expect older children, who have been exposed to systematic religious teaching in school, to distinguish more sharply between magical and religious stories, as compared to the younger children who have not started formal education.

Our second question focused on children’s *justifications* for their reality status judgments. To corroborate findings from children’s reality status judgments, we asked whether their justifications reflected a domain-general or a domain-specific pattern. To answer this question, we examined the mechanisms children invoked when justifying their reality status judgments. Given that children use their understanding of causality to reason about possibility, we anticipated that our participants would refer primarily to causal elements of the stories when justifying their real or pretend judgments, and that they would do so across all story types.

The domain-general and the domain-specific accounts make different predictions about justifications for magical stories. The domain-general account predicts that not only will children judge such stories to be possible, but that they will also justify that judgment by invoking and endorsing the magical mechanism described in the story. By contrast, the domain-specific account predicts that children will often judge such stories to be impossible and justify that judgment by explicitly rejecting the magical mechanism described in the story.

Moreover, with age, we would expect children to make more systematic use of their understanding of causality as they develop a more mature understanding of causal possibility (Sobel et al., 2004). This mature understanding, in turn, should translate into more systematic references to causal violations of magical stories among older children.

## Method

### Participants

Expecting a moderate effect size, ( $f = .25$ ) and  $\alpha = .05$ , based on an  $F$ -test with three degrees of freedom, we determined

that a sample size of 40 per age-group was appropriate for our comparisons. Eighty-five children participated: 42 5- to 6-year-olds ( $M = 5.74$ ,  $SD = 0.44$ , 22 girls) and 43 9- to 10-year-olds ( $M = 9.72$ ,  $SD = 0.45$ , 20 girls). We oversampled by a few more children in each age-group to compensate for anticipated missing data or experimenter error.

Participants were recruited through social media, word of mouth, or from local cultural centers offering extracurricular summer classes to children free of charge. Advertisements about the study were posted on social media groups and “channels” devoted to parenting or children’s events. Families who were recruited through social media travelled to the Mother-Child Center, a university-affiliated research and therapy center in Tehran. Testing at this center took place in a quiet room with individual children. Families who were recruited from local cultural centers were informed by the center about the study, and individual children were tested during breaks and between classes, in a quiet classroom in these cultural centers, located in various neighborhoods of Tehran. This sampling method ensured diversity and representativeness because the sample was not limited to a specific neighborhood or group. Parents identified their religious denomination as part of a parent questionnaire. All parents, with the exception of three who identified as “not affiliated with any religion,” identified as Muslim. For reasons of confidentiality, all information was collected anonymously. Parents did not sign a consent form but were provided with an information sheet and asked to provide verbal assent if they agreed to their child’s participation in the study. All children were also presented with information about the study verbally and provided verbal assent before testing took place. The institutional review board at Boston University approved this approach.

## Procedure and materials

Participants were randomly assigned to one of two conditions: *Event-focused* or *character-focused*.

**Task introduction** Participants in both conditions were first introduced to a categorization task. The experimenter told the participant that she had a set of pictures of people [or events], which were all mixed up, and asked the participant to help her sort them. Then, she introduced two folders, one with a photographic image of a boy sitting at a school desk – the “real” folder – and one with a drawing of a lion painting a picture – the “pretend” folder. She explained that real characters/events should go in the “real” folder and pretend characters/events should go in the “pretend” folder. To familiarize children with the procedure, they were presented with a brief realistic story that was either character-focused (“for example, you may have heard a story about your mommy when she was a little girl”) or event-focused (“or a story

about an accident that really happened a long time ago”). Participants were also presented with a brief pretend story that was either character-focused (“you may have heard a story about a superhero who fought and defeated a dragon”) or event-focused (“or a story about a house and all the people inside rising from the ground and floating in space”). Order of presentation was randomized. After hearing each individual story, participants were asked to indicate which folder the story belonged to. The aim of the task was explained to the participants one more time before the warm-up trials.

## Warm-up

Next, participants were presented with four warm-up trials in which they were asked to categorize two real characters (*Amoo Poorang* and *Rambod Javan*, both well-known TV program hosts in Iran) in the character-focused condition and two ordinary events (building a house out of wood and kayaking) in the event-focused condition. They were also asked to categorize two pretend characters (*Sponge Bob*, and *Ben 10*, both well-known cartoon characters in Iran) in the character-focused and two pretend events (an elephant flying in the sky and a frog talking) in the event-focused condition. Order of presentation was randomized. For each character/event, children were shown a card with the corresponding picture, asked whether they had heard anything about the character/event, and invited to place the card in one of the two folders. If children did not initially place the card in the appropriate folder, feedback was provided, and they were then invited to try again. Only three children did not accurately categorize the warm-up characters/events at the first attempt. All children completed this task successfully after at most one round of feedback.

## Categorization task

Immediately following the warm-up task, each participant was presented with three realistic, three magical, three religious, and three unusual stories in counterbalanced order, followed by four stories from the Koran.<sup>1</sup> The stories were

<sup>1</sup> Explicitly Koranic stories were included as a pilot exploration of stories already familiar to most of the children. These stories were excluded from our main analyses because they were not presented in the same way as the other four story types. Specifically, presentation of the Koranic stories was not random (they were always presented last), and there was only one version of each Koranic story, whereas all other stories had four versions that were systematically counterbalanced. In our preliminary analysis, when we compared judgments and justifications of Koranic stories with the other stories, we found that these stories behaved in a very similar way to the other religious stories. The four stories from the Koran included the story of Moses adrift on the river Nile, the story of Noah’s ark, the story of Moses’ stick turning into a snake, and the story of Jesus speaking as an infant. All character names were changed.

identical in the event- and character-focused conditions. Within participants, the content of each of the 12 stories was unique but story type was repeated (three of each type: Realistic, magical, religious, and unusual).

The stimuli used for presentation of 12 stories per participant included 12 main story contexts/characters, each with four versions (realistic, magical, religious, and unusual). The realistic, magical, religious, and unusual versions of the stories were created by varying the manner in which the story resolution was achieved, thereby creating four versions of the same story. All four versions shared a common premise and a common introduction (e.g., This is Elina; one year, crops did not grow in Elina’s town and people had nothing to eat), as well as a common resolution (e.g., Elina fed hundreds of hungry people in her town). The key difference among the four versions of each story was the way in which the resolution came about. In the realistic version of each story, the resolution involved only physically and biologically possible processes (e.g., Elina traveled to a far-away city and bought bread for everyone in her town). In the magical version, the resolution involved magic and/or fairies (e.g., Using her magical powers, Elina made bread out of air). In the unusual version, the resolution involved possible but highly implausible processes (e.g., Walking in the forest, Elina found many loaves of bread). Lastly, the religious version involved an intervention by a divine power (e.g., With the power that God gave her, Elina created many loaves of bread out of one; see all materials, including all stories in Persian, on the Open Science Framework (OSF) link here: <https://osf.io/h3wrf/>). Each child heard only one version of each story. For example, they heard only one of the four versions (realistic, magical, religious (non-Koranic), or unusual) of Elina’s story (see Table 1). Each story was accompanied by a card displaying a photographic picture relevant to the story content. Finally, as noted, all participants received the same four stories from the Koran.

After being presented with each story and the corresponding card, children were asked to categorize the story

by placing the card into the “real” or “pretend” folder. In the character-based condition, they were asked whether they thought the character was real or pretend (e.g., “Do you think Elina is real or pretend?”) and invited to place the card with a photo of the character into the “real” or “pretend” folder. In the event-based condition, they were asked whether they thought the event was real or pretend (e.g., “Do you think what happened is real or pretend?”) and invited to place the card with a photo of the event into one of the two folders.

### Justification task

After children made their judgment about whether the character/event was real or pretend by placing the card into the respective folder, they were invited to justify their decision: “So you put the card in the ‘real’/‘pretend’ folder. Why do you think it goes in the ‘real’/‘pretend’ folder?” Children were prompted twice, and if they did not respond, the experimenter moved on.

**Coding** Children’s justifications were coded into six mutually exclusive categories: Causal mechanism, non-causal features, testimony, direct encounter, visual/pictorial, and uninformative. Each category is described in detail below.

**Causal mechanism** Of main interest was children’s attention to the causal mechanism. This category was based on whether children referred to the main causal mechanism in the story. Recall that the four story types differed in terms of *how* a given resolution was brought about (see Table 1 – causal mechanisms are in bold). Given our interest in children’s ability to reason about reality status based on the type of cause, all justifications were first coded for whether or not they referred to the causal mechanism responsible for bringing about the story resolution. For example, hearing the *religious* story of Elina, if a participant indicated that Elina is not real because, “God does not give people such special powers”, the justification was coded as referring to the target

**Table 1** Four versions of one of the stories (Elina’s story) varying as a function of the main causal mechanism (in bold). All stories are available on the Open Science Framework (OSF) in English and Persian [<https://osf.io/buph5/>]

| Realistic  | Magical   | Unusual  | Religious  |
|--|---|--|--|
| This is Elina. One year, the crops in Elina’s hometown did not grow and the people had nothing to eat. <b>Elina traveled to a town far away and bought enough loaves of bread for everyone in the town. She took them back home.</b> Then she was able to feed hundreds of hungry people | This is Elina. One year, the crops in Elina’s hometown did not grow and the people had nothing to eat. <b>Elina used her magical powers to make many loaves of bread out of thin air!</b> Then she was able to feed hundreds of hungry people | This is Elina. One year, the crops in Elina’s hometown did not grow and the people had nothing to eat. <b>Elina was walking in the forest and she found many, many loaves of bread. She took them back home.</b> Then she was able to feed hundreds of hungry people | This is Elina. One year, the crops in Elina’s hometown did not grow and the people had nothing to eat. <b>Elina took two loaves of bread and, with the power of God, she turned them into many, many loaves.</b> Then she was able to feed hundreds of hungry people |



cause (see Gong & Shtulman, 2021). Note that references to the main causal mechanism could involve endorsement of that mechanism or rejection of it (as in the preceding example).

Examples of justifications that referred to the main cause included the following: “Because she asked for God’s help and God can help anyone in any way”—in response to a *religious* story where the main character asks for God’s help; “A magical guitar exists only in cartoons, like if you want to fight an animal and then you use a magical guitar to break the animal’s horn in the movies”—in response to a *magical* story where the main character plays a magical guitar until the walls of a palace fall; “Because you cannot look at clouds and tell from the clouds [whether it will rain]”—in response to a *realistic* story where the main character foresees rain by looking at the clouds; “Because there must have been some water leaking through the tunnel”—in response to an *unusual* story where the main character finds an underwater tunnel to cross the sea.

Our main interest was to understand patterns of reference to causal mechanisms. Accordingly, we coded justifications for the following non-causal features only if participants did not mention the target-cause as the main reason for their real/pretend judgment:

**Non-causal features** Non-causal features of stories were sometimes used to justify a reality judgment. For example, children sometimes referred to “kings” as not being real or as being real (when the story featured a king). These non-causal features included story elements which did not differentiate story types (i.e., the existence of a king was a common element across the four versions of the same story). Further examples included the following: “Because she was sick”—in response to a story in which the main character was sick, or “Because he is not a hero”—in response to a story in which the main character was imprisoned in a dungeon but escaped.

**Testimony/source** When children referred to the source of their knowledge to justify their “real” or “pretend” classifications, their justification was coded as based on testimony. This included cases where children explicitly mentioned having heard/never heard about the story from others or read the story (“I’ve heard this story many times”; “I’ve never heard this story before”; “I’ve read this story before”). This category further included cases where children asserted that there was a story like the one they just heard (“This is Moses’ story, not Sasan’s”; “This is Moses’ story”; “I’ve only heard this about prophets”), and cases where children referred to films/cartoons portraying the story (“I’ve seen this in a cartoon that showed Moses’ story”).

**Direct encounter, visual/pictorial, and uninformative** Children sometimes stated that they had personally come across or experienced something identical to, or similar to, elements in the story. These justifications included statements like, “Because one day I was on a boat with my family and I was able to swim and get out of the water”—in response to a story where the main character falls out of a boat. Likewise, children sometimes justified their “pretend” classification by stating that they had never personally “seen” anything like the story in question (“Because I’ve never seen a drink like this”). Both kinds of statements were coded as invoking direct encounters.

Children also sometimes referred to aspects of the visual depiction presented along with the story. These included reference to the photo depicting a real person (e.g., “This is a photo of a real person”) or to having seen the person portrayed in the photo (e.g., “I’ve seen this guy on channel 20”; “I’ve seen this person before”). These were coded as visual/pictorial.

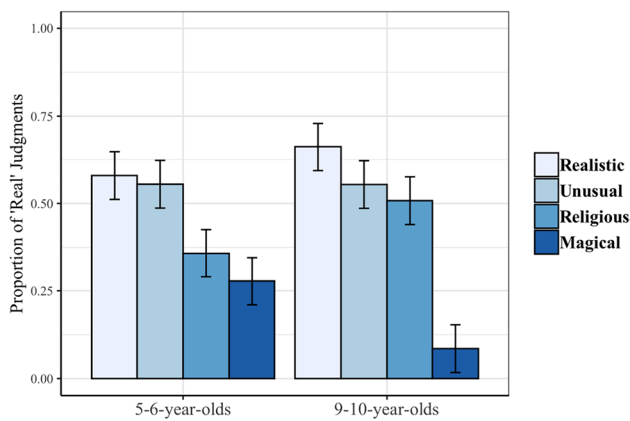
Finally, many justifications were uninformative: They did not make sense in the context of the stories, or included “I don’t know” responses, circular phrasing (“It just doesn’t exist”; “It just is”, “This can happen”), or irrelevant answers (e.g., “This was an easy one, I thought about the answer”, “People in the past did not know”). All such responses were coded as “uninformative.”

**Reliability** All justifications were coded in the original language, Persian, by the two first authors who have native proficiency in Persian. Agreement was 82% (308 justifications out of 384 total coded justifications). Percentage of agreement expected by chance is 32.8% of all coded justifications, given six coding categories. There was substantial reliability in coding ( $Kappa = 0.74$ ,  $SE = 0.03$ ,  $CI [0.68, 0.79]$ ). Cases where agreement did not occur at first were discussed between the two coders and consequently resolved.

## Results

### Rank ordering of story types with respect to children’s reality judgments as a function of age

Figure 1 shows the proportion of story characters/events of each type (realistic, unusual, religious, and magical) judged as real by 5- to 6-year-old and 9- to 10-year-old children. As shown in Fig. 1, the two age groups displayed a similar rank ordering in their judgments of the four story types. Overall, however, older children were more likely than younger children to judge stories as real, with the notable exception of magical stories, which younger children were more likely to judge as real. As predicted by the domain-specific model of the effects of religious testimony on children’s reality



**Fig. 1** Proportion of stories judged as “real” by children in each age group, as a function of story type

judgments, older children differed from younger children in judging religious stories as more similar to unusual and realistic stories but as more different from magical stories. Thus, as confirmed by inspection of Fig. 1, whereas younger children distinguished between broad categories – strictly realistic stories vs. supernatural stories, including magical and religious – older children clearly differentiated between religious and magical stories.

To statistically test for these patterns, we conducted a series of mixed-effects binomial logistic regression models in *R*, using the *glmer* function from the *lme4* package. We defined a random intercept to account for story type as a repeated measure within participant ID. In a preliminary analysis, we asked whether children’s reality judgments differed between the two conditions (i.e., whether focusing on characters or events in the stories impacted the likelihood of “real” judgments). Condition did not significantly impact the likelihood of reality judgments ( $B = -0.15$ ,  $SE = 0.27$ ,  $z = -0.55$ ,  $p = 0.58$ ), and was therefore dropped from subsequent models.

In the following models, we included Story Type as a predictor and changed the reference level three times to account for all comparisons. Each of these three models also included Age Group and the interaction term between Story Type and Age Group as predictors. Table 2 shows the results from these models.

As shown in Table 2 (Models 1 and 2), overall, religious and magical stories were judged as real less often than realistic and unusual stories. However, the differentiation between realistic and magical stories increased with age (see Table 2: Significant interaction between Age Group and Story-Type in Model 1) because older children, as compared to younger children, more systematically categorized magical stories as “pretend” ( $B = -1.97$ ,  $SE = 0.66$ ,  $z = -2.97$ ,  $p = 0.003$ ,  $OR = 0.14$ ,  $CI [0.04, 0.51]$ ). The differentiation between religious and magical stories also increased with age (see Table 2:

Significant interaction between Age Group and Story-Type in Model 3) because older children, as compared to younger children, more systematically categorized religious stories as real ( $B = 0.73$ ,  $SE = 0.32$ ,  $z = 2.08$ ,  $p = 0.037$ ,  $OR = 2.09$ ,  $CI [1.04, 4.16]$ ).<sup>2</sup> Thus, older children systematically judged magical stories as pretend, but they were prone to accept religious stories as real.

In sum, although children in both age groups distinguished strictly realistic stories (i.e., realistic and unusual stories) from stories with either religious or magical elements, older children – with several years of formal schooling – also differentiated between religious and magical stories, judging religious stories more often as real and magical stories more often as pretend.

### Cause-based justifications as a function of story type and schooling

Next, we examined the justifications that children provided after having judged stories as either real or pretend. Figure 2 shows the frequency of the six categories of justification offered by children in support of their “real” and “pretend” judgments of each story type (A and B panels, respectively). Having judged stories as real (see Fig. 2A), 5- to 6-year-old children provided uninformative justifications about half of the time (the remaining five coding categories making up the other half); only occasionally did younger children offer causal justifications. By contrast, older children mostly provided causal justifications except for magical stories, which in any case, they had rarely judged as “real”. Having judged stories as pretend (see Fig. 2B), younger children invoked either causal or non-causal features of the stories with approximately similar frequency, whereas older children mostly invoked causal features.

To examine the frequency with which children provided causal justifications, we conducted mixed-effects binomial logistic regression models on the likelihood of referring to the causal mechanism versus any other category. We first asked whether Condition (character- vs. event-focused) had an effect on the justifications generated following “real” judgments ( $B = 1.58$ ,  $SE = 0.52$ ,  $z = 3.04$ ,  $p = 0.002$ ). Children in the event-based condition referred more often to causal mechanisms as compared to the children in the character-focused condition. Accordingly, controlling for the effect of Condition in all subsequent models, we first analyzed the causal justifications that children offered after judging a story as real. The first model included Age Group, Story Type and their interaction as predictors, accounting for individual-level variability with Story Type, and controlling for Condition. The interaction

<sup>2</sup> Younger and older children did not statistically differ in their reality judgments of the realistic or unusual stories.

**Table 2** Estimates from mixed-effects binomial logistic regression on “real” vs. “pretend” judgments as a function of Age Group, Story-Type, and Age Group  $\times$  Story-Type

| <b>Model 1 – “Realistic” as reference for Story Type</b> |                 |                   |          |
|--|-----------------|-------------------|----------|
|  | <i>B (SE)</i>   | <i>OR [CI]</i>    | <i>z</i> |
| Intercept  | 0.41 (0.26)     | 1.51 [0.90, 2.53] | 1.55     |
| Age Group  | 0.40 (0.37)     | 1.49 [0.71, 3.09] | 1.06     |
| <b>Story Type (levels compared to Realistic)</b>         |                 |                   |          |
| Unusual  | -0.12 (0.29)    | 0.89 [0.50, 1.57] | -0.40    |
| Religious  | -1.15 (0.30)*** | 0.32 [0.17, 0.57] | -3.79    |
| Magical  | -1.61 (0.32)*** | 0.20 [0.11, 0.37] | -5.08    |
| <b>Interaction</b>                                       |                 |                   |          |
| Unusual (vs. Realistic) $\times$ Age Group               | -0.45 (0.41)    | 0.64 [0.29, 1.43] | -1.09    |
| Religious (vs. Realistic) $\times$ Age Group             | 0.40 (0.42)     | 1.49 [0.66, 3.38] | 0.95     |
| Magical (vs. Realistic) $\times$ Age Group               | -1.97 (0.51)*** | 0.14 [0.05, 0.38] | -3.83    |
| <i>AIC</i>   | 1193.7          |                   |          |
| <i>BIC</i>   | 1242.9          |                   |          |
| <i>Log Likelihood</i>                                    | -586.8          |                   |          |
| <i>Deviance</i>  | 1173.7          |                   |          |
| <b>Model 2 – “Unusual” as reference for Story Type</b>   |                 |                   |          |
|  | <i>B (SE)</i>   | <i>OR [CI]</i>    | <i>z</i> |
| Intercept  | 0.30 (0.26)     | 1.34 [0.80, 2.24] | 1.12     |
| Age Group  | -0.06 (0.37)    | 0.90 [0.46, 1.95] | -0.14    |
| <b>Story Type (levels compared to Unusual)</b>           |                 |                   |          |
| Religious  | -1.03 (0.30)*** | 0.36 [0.20, 0.64] | -3.43    |
| Magical  | -1.49 (0.31)*** | 0.22 [0.12, 0.42] | -4.76    |
| <b>Interaction</b>                                       |                 |                   |          |
| Religious (vs. Unusual) $\times$ Age Group               | 0.84 (0.41)*    | 2.33 [1.04, 5.22] | 2.05     |
| Magical (vs. Unusual) $\times$ Age Group                 | -1.52 (0.50)**  | 0.22 [0.08, 0.59] | -3.01    |
| <b>Model 3 – “Religious” as reference for Story Type</b> |                 |                   |          |
|  | <i>B (SE)</i>   | <i>OR [CI]</i>    | <i>Z</i> |
| Intercept  | -0.73 (0.27)**  | 0.48 [0.29, 0.81] | -2.74    |
| Age Group  | 0.79 (0.37)*    | 2.20 [1.07, 4.51] | 2.14     |
| <b>Story Type (levels compared to Religious)</b>         |                 |                   |          |
| Magical  | -1.45 (0.30)    | 0.63 [0.35, 1.16] | -1.48    |
| <b>Interaction</b>                                       |                 |                   |          |
| Magical (vs. Religious) – Age Group                      | -2.34 (0.50)*** | 0.10 [0.04, 0.25] | -4.70    |

*AIC*, *BIC*, *Log Likelihood*, and *Deviance* parameters from Model 1 apply to all models

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

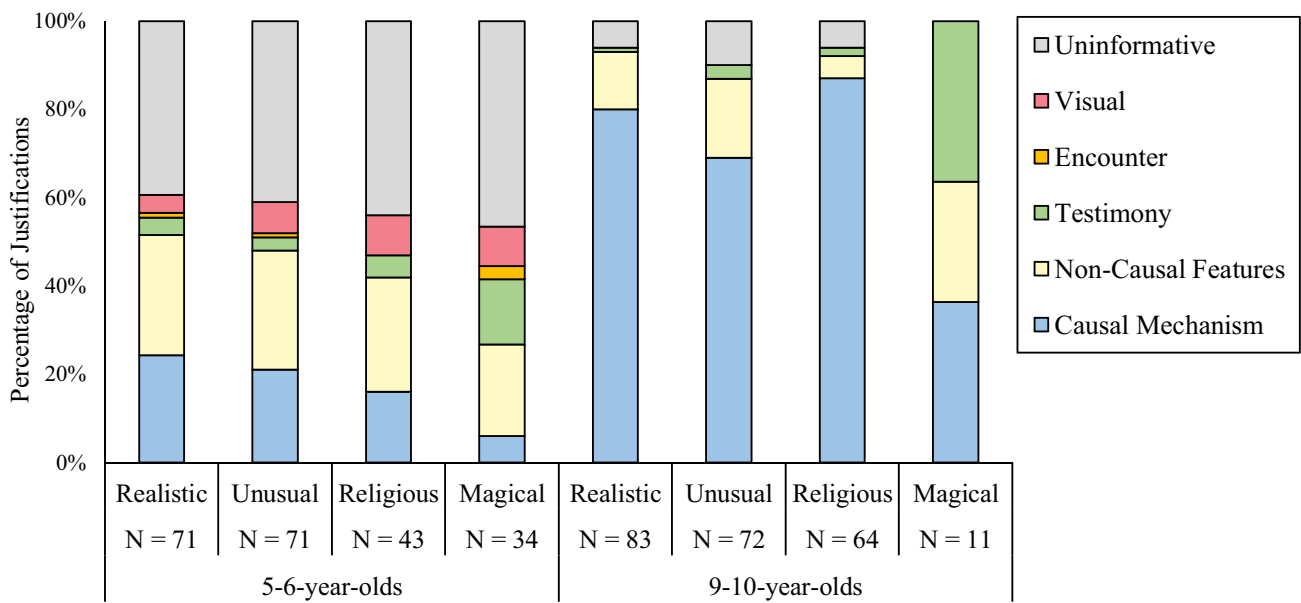
between Age Group and Story Type was not significant ( $X^2 = 6.52$ ,  $p = 0.09$ ). Accordingly, we dropped the interaction term in the next model, and only included Age Group and Story Type as predictors. We changed the reference level for Story Type three times to investigate differences among all story types. Table 3 (top panel) shows these results.

As expected, Age Group was a significant predictor ( $B = 1.43$ ,  $SE = 0.38$ ,  $z = 3.72$ ,  $p < 0.001$ ), indicating that older children were more likely than younger children to justify their real judgments by referring to a causal mechanism. Turning to differences between story types, as shown

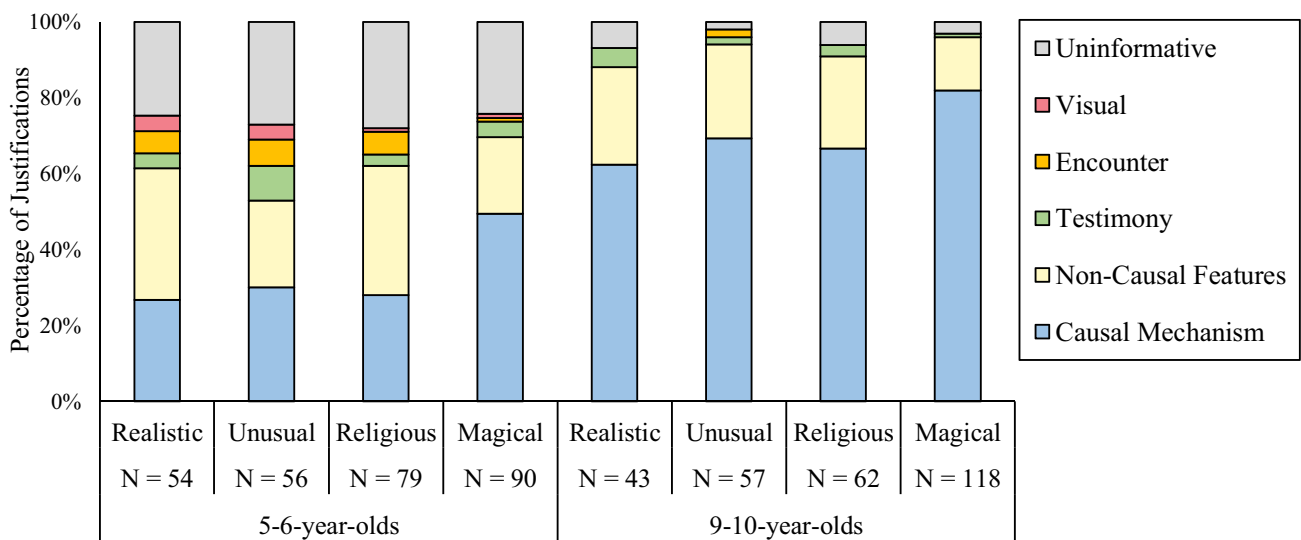
in Table 3 (top panel), when children judged realistic and unusual stories as real, they justified their decision by referring to the causal mechanism in the stories at a similar rate. Children were slightly more likely to refer to causal mechanisms to justify religious stories as “real” as compared to unusual stories, but did so at similar rates to realistic stories. However, as compared to these three story types, children referred to the causal mechanism less often for magical stories (although note the small  $N$  for magical stories judged as real). These patterns are mostly driven by the older children because the younger children produced causal justifications less often.



A). When judging stories as “real”



B). When judging stories as “pretend”



**Fig. 2** Percentage of six types of justifications offered for judging stories as real (panel A) or pretend (panel B), by age group and type of story. **A)** When judging stories as “real”. **B)** When judging stories as “pretend”. *Note:* *N* shows the number of each type of story judged as

real (panel A) or as pretend (panel B). Note that for magical stories judged as “real”, *N* is very small, especially among older children (*N* = 11) – reflecting the findings shown in Fig. 1

We next investigated the likelihood of referring to a causal mechanism after judging stories as pretend. We ran the same models as above. However, Condition was not a significant predictor of cause-based justifications backing up “pretend” judgments ( $B = 0.21, SE = 0.37, z = 0.58, p = 0.56$ ). Thus, the subsequent models did not control for Condition. In the first model, the interaction between Age

Group and Story Type was not significant ( $X^2 = 0.20, p = 0.98$ ). Accordingly, in the subsequent models, the interaction was not included. As expected, Age Group was a significant predictor, with older children offering causal justifications more often than younger children ( $B = 1.87, SE = 0.30, z = 6.17, p < 0.001$ ). Table 3 (bottom panel) shows how the different story types compared with respect to references

**Table 3** Comparing different story types as predictors in mixed-effects binomial logistic models on justifications referring to Causal Mechanisms versus all other justification categories

| When classifying stories as “Real”    |                   |                   |                   |
|---------------------------------------|-------------------|-------------------|-------------------|
| Story Type                            | Unusual           | Religious         | Magical           |
| <i>Realistic</i>                      |                   |                   |                   |
| <i>B (SE)</i>                         | -0.57 (0.32)      | 0.23 (0.36)       | -2.06 (0.68)**    |
| <i>OR [LL, UL]</i>                    | 0.57 [0.30, 1.07] | 1.25 [0.62, 2.53] | 0.13 [0.03, 0.46] |
| <i>Unusual</i>                        |                   |                   |                   |
|                                       |                   | 0.79 (0.37)*      | -1.50 (0.65)*     |
|                                       |                   | 2.21 [0.07, 4.56] | 0.22 [0.06, 0.81] |
| <i>Religious</i>                      |                   |                   |                   |
|                                       |                   |                   | -2.29 (0.68)***   |
|                                       |                   |                   | 0.10 [0.03, 0.38] |
| When classifying stories as “Pretend” |                   |                   |                   |
| <i>Realistic</i>                      |                   |                   |                   |
|                                       | 0.23 (0.33)       | 0.01 (0.32)       | 0.96 (0.30)**     |
|                                       | 1.27 [0.66, 2.44] | 1.01 [0.54, 1.89] | 2.62 [1.45, 4.74] |
| <i>Unusual</i>                        |                   |                   |                   |
|                                       |                   | -0.22 (0.30)      | 0.72 (0.28)*      |
|                                       |                   | 0.80 [0.44, 1.45] | 2.07 [1.18, 3.62] |
| <i>Religious</i>                      |                   |                   |                   |
|                                       |                   |                   | 0.95 (0.26)***    |
|                                       |                   |                   | 2.58 [1.54, 4.34] |

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

to a causal mechanism. As shown in Table 3, only magical stories stood out among the four story types. Irrespective of age, children were more likely to invoke – but reject – the causal mechanism described in magical stories as compared to realistic, unusual, or religious stories. Thus, an outcome that was allegedly caused by magic was more salient to children – but also more dubious – than when it is brought about by other causal mechanisms.

In summary, older children referred to the causal mechanism in the story more often than younger children, and this age difference emerged whether children invoked the causal mechanism to justify their judgment that the event/character was real or that it was pretend. Irrespective of age, children rarely justified their reality judgments for magical stories by affirming magical causation whereas they often justified their pretend judgments for magical stories by denying magical causation.

## Discussion

Our findings examined whether religious exposure has a domain-general or domain-specific influence on children’s reasoning about possibility in a society where children are exposed to consistent religious teaching. Iranian children’s possibility judgments and their justifications for these judgments across various story types cast doubt on the hypothesis that religious exposure, even in the wake of consistent and cumulative religious teaching over development, leads to a domain-general effect on children’s reasoning about

possibility. Instead, they support the hypothesis that the developmental impact of religious exposure on children’s acceptance of causally impossible occurrences is limited to religious contexts. Below, we review these findings and discuss further implications and limitations. We first discuss children’s possibility judgments and the implications of our findings before turning to the justifications that children provided to support those judgments.

Five- to 6-year-old Iranian children and 9- to 10-year-olds distinguished between realistic and unusual stories on the one hand and religious and magical stories on the other. Older children – after cumulative exposure to religious teachings for several years – also distinguished between religious and magical stories. Specifically, older children judged characters and events embedded in stories with religious causal elements (e.g., God helping a character in need) as real more often than they did for characters and events embedded in stories with magical elements (e.g., fairies helping a character in need).

We extend prior work by examining the influence of religious education over development. Corroborating prior findings, we document an effect of religious education on children’s reasoning about possibility (see Corriveau et al., 2015; Davoodi et al., 2016; Payir et al., 2021). With more exposure to consistent religious testimony, children in our sample show a developmental change from an unsystematic to a systematic differentiation between divine causation and other types of supernatural causation. Also consistent with prior work, our findings show that with age, children systematically recognize the magical as unreal.

One possible explanation for this developmental pattern is that older children’s understanding of the impossibility of magic is more advanced. With age, belief in the fictional and magical declines among children from various Abrahamic traditions (see Chandler & Lalonde, 1994; Johnson & Harris, 1994; Subbotsky, 1994; and see Woolley et al., 2004, for an overview of developmental factors contributing to a belief in novel fantastical beings). Although this might explain the decrease in “real” judgments for magical stories among the older children in our sample, it does not account for the increase in “real” judgments for religious stories. We infer that, especially among older children, cumulative and consistent exposure to religious teachings at school and at home solidifies a domain-specific pattern of reasoning about religious miracles as possible, a pattern of reasoning that does not “carry-over” to their understanding of magical causation. That said, older children’s more mature understanding of magic as impossible might further contribute to this domain-specific pattern of influence. However, within the design of the current study, we are unable to tease apart the relative contribution of cognitive developmental processes regarding magical causation versus the cumulative presentation of stories with miraculous events and divine

intervention as real. This is a limitation of the current design because our sample does not include non-religious children. Recruiting children with no, or minimal, religious exposure in Iran would be particularly challenging, if not impossible, due to consistent community exposure to religious beliefs and teachings through various sources. Children with no religious exposure within Iranian society would have to be systematically shielded from mainstream societal messages and indeed from everyday conversations in which God is frequently invoked. Hence, they would represent extreme outliers in the population.

Two alternative explanations relating to our study design are worth considering. The first explanation is that our warm-up task, where children received feedback about their categorization of real and pretend characters and events (e.g., “yes, that’s right” after a correct categorization) may have contributed to their judgments of magical stories. Specifically, children could have learned that pretend characters and events are unreal, and subsequently used this knowledge to judge the magical stories in the main trials as pretend. Although we cannot fully discount this possibility, we believe that this one-time feedback was most likely insufficient to yield generalized learning. Importantly, with the exception of only three children, all participants accurately applied their prior knowledge and categorized the characters and events accurately as “real” or “pretend” at their first attempt during the warm-up task.

The second alternative explanation has to do with the fact that in addition to the main causal agent in the story, the religious and magical stories also differed with respect to specific details. For example, in the magical version of Elina’s story, she made many loaves of bread out of thin air but in the religious version, God helped her make many loaves of bread out of two loaves. This difference might have contributed to older children’s ability to distinguish between the religious and magical stories, independent of the role of religious testimony. That is, children might have learned, based on statistical information or daily observations, that certain events are more likely than others (see Shtulman & Morgan, 2017). However, it is unlikely that these subtle differences between the story events can explain the overall pattern observed in our sample. Corriveau et al. (2015) showed that even when exactly the same event is described to children but with and without the inclusion of the word “magic,” they are more likely to judge the stories with the “magical” event as pretend. By implication, children’s conception of magic is independent of their reasoning about event details. Moreover, religious children in the study by Corriveau et al. (2015) judged familiar religious stories involving magic less often as “real” compared to familiar religious stories not involving magic. Thus, consistent with these prior findings, a more plausible explanation for the differentiation between magical and religious stories, especially among older children,

emphasizes the role of religious education. Going beyond prior work, however, the developmental patterns presented here suggest that the impact of religious exposure on children’s possibility judgments does not extend beyond their reasoning about divine causality.

Another important finding worth discussing is that despite the developmental differentiation between religious stories as more real and magical stories as more pretend, religious stories were still judged as real less often than realistic stories, even among older children. Why might this pattern hold if religious exposure contributes to domain-specific reasoning about religious stories as real? We speculate that there may be different learning mechanisms at play when children reason about realistic, as opposed to divine, causation. Specifically, although children can rely on first-hand experience and early intuitive theories of physical, biological, and mental causation in learning about realistic causal processes (e.g., Carey, 1995; Gelman & Kremer, 1991), they may be obliged to rely on cultural testimony in learning about divine causation (e.g., Boyer & Walker, 2000; see Davoodi & Clegg, 2021). In our study, older children distinguish less sharply between those strictly realistic stories that they themselves had presumably not experienced (i.e., the unusual stories) and religious stories, whereas they continued to clearly distinguish between the realistic stories with everyday cause-effect mechanisms and religious stories. This might suggest a developmental process by which cultural testimony takes over in cases where opportunities for direct first-hand experience are restricted or impossible (see Danovitch & Lane, 2020; Lane, 2018).

Other findings from research with Iranian children are consistent with this possibility. Studies on beliefs about religious and scientific unobservable entities and processes among Iranian children and adults show that, despite their religious convictions, 5- to 7-year-old children and adults are slightly more confident about the existence of scientific entities (Davoodi et al., 2018). One possible explanation for this pattern is that although the existence of both scientific and religious entities might be inferred from consistent cultural testimony, the properties of scientific entities may nevertheless more readily align with the developing understanding of causal regularities, compared to the properties of religious entities (see Davoodi & Clegg, 2021). Following the same reasoning, the causal regularities described in the realistic stories in our design might be more aligned with children’s intuitive causal understanding, whereas divine causality described in the religious stories is mainly supported by societal testimony. This could explain why Iranian children distinguish religious stories from strictly realistic stories. In further contrast, magical stories neither align with children’s intuitive causal understanding, nor are they supported by societal testimony. This account suggests that with respect to the frequency of children’s reality judgments, religious

stories should fall in between the strictly realistic stories (i.e., realistic and unusual stories in our study) and magical stories. This is the pattern we observe.

Despite children's overall differentiation among story types, the absolute numbers of children judging the realistic stories as "real" is surprisingly low, as shown in Fig. 1. This is inconsistent with prior work with children from the same age ranges in the USA (see Payir et al., 2021, where about 80% of 5- to 7-year-old and 8- to 11-year-old children judge the realistic stories as real; Corriveau et al., 2015, where more than two-thirds of 5- to 6-year-olds judge the realistic stories as real). We speculate that cultural variability in the kinds of stories that children are regularly exposed to contributes to this inconsistency. The stimuli developed for the current study were part of a large cross-cultural project including USA, Chinese<sup>3</sup>, and Iranian samples. The original team of researchers, however, were all USA-based, and although a multicultural team of researchers collaborated to create the stories, the stimuli were largely adapted from prior work with children in the USA. Accordingly, it is possible that the premises of these stories sounded somewhat unfamiliar or strange (e.g., the existence of a king; a young girl going into a forest looking for bread) to children from other cultures, even when no supernatural or unusual elements were included. Two pieces of evidence support this possibility. First, as shown in Fig. 2B, when children categorized the realistic stories as "pretend", a considerable percentage of children referred to non-causal elements of the story to justify their classification (e.g., "kings," "lions"; see "non-causal" in Fig. 2B: 35% of 5- to 6-year-old children and 26% of the 9- to 10-year-olds refer to these elements). Second, in previous research with Iranian children, Davoodi and her colleagues (2016) created stories specifically designed with Iranian children in mind and after consultation with local researchers and parents. Similar to the current study, children from Davoodi and colleagues' (2016) paper classified the stories as real or pretend. Importantly, 79% of 3- to 4-year-old children and 86% of 5- to 6-year-old children judged the realistic versions of the stories as real (both groups were above chance; see Fig. 1 in Davoodi et al., 2016). This further confirms the relevance and value of local cultural knowledge in psychological research.

Turning to children's justifications, 9- to 10-year-olds often appealed to causal elements in the stories to back up their "real" and "pretend" judgments, whereas 5- to 6-year-olds often provided uninformative justifications. Importantly, supporting the possibility of domain-specific influences of religious exposure on causal reasoning, children were especially likely to refer to causal violations in magical

stories when judging these as pretend. This suggests that religious exposure does not commit children to an unconstrained conception of causality where causal violations are generally possible. In fact, children in our sample were not desensitized to the causal violations embedded in the magical stories, as was evident in their frequent references to these violations when justifying their judgment of magical stories as "pretend." Yet, religious exposure leads children to conceive of "divine" causation as possible; indeed, even when judging stories as pretend, children cited the alleged cause as an impossibility less often in the context of religious as compared to magical stories. These patterns further confirm the domain-specific role of a religious education as a major source of influence on children's causal reasoning. In the case of children in our sample, a religious education seems to directly present and reinforce the possibility of religious causation as real (see Harris 2012, 2013; see also Payir et al., 2021).

In conclusion, our findings corroborate prior work on children's increasing differentiation between reality and magic. Contrary to prior speculation (Corriveau et al., 2015; Davoodi et al., 2016), we also show that exposure to religious instruction does not lead to a flexible or loose conception of causality; rather, it leads children to increasingly affirm the possibility of divine causation and to deny the possibility of magical causation.

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#### Declarations

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There are no conflicts of interest to report.

The study was approved by the IRB of the relevant institutions.

Parents of all child participants were provided an information sheet and verbally assented to the study. Children verbally assented. For reasons of confidentiality, no signatures or identifiable information were collected.

We consent to this paper being published by the publisher upon acceptance.

All data, analysis codes, and materials are available and open on the Open Science Framework (OSF) at: <https://osf.io/fbt73/>

The study was not preregistered.

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<sup>3</sup> Preliminary analysis with the Chinese sample also shows that "real" judgments for the realistic stories are lower than patterns found among children in the USA

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