

CAN MAGIC MAKE IT POSSIBLE? AN EXAMINATION OF AGE DIFFERENCES
IN CHILDREN'S USE OF MAGIC AS AN EXPLANATORY TOOL FOR
IMPOSSIBLE AND IMPROBABLE OUTCOMES

by

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DEDICATION

To my late grandfather, Joe Antonio Quintero, who never saw this adventure but remains in my heart forever.

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ABSTRACT

A body of existing literature suggests that magical thinking shapes the thoughts and behavior of children. Many children attribute fantastical causes to events that seem impossible in the real world. Previous studies found that older children are less likely to use magic as an explanation to events that violate causal laws, underlining that magical thinking decreases with age. Findings suggest that as children age, they rely less on magical thinking to explain the events they see. However, not much is known about age differences in children's evaluations of magic as a cause of impossible versus improbable events. This study examines the intersection of children's reasoning about whether magical objects help make impossible and improbable events occur. In the initial round of data collection, 15 participants completed an online Zoom interview, which included questions about the possibility of impossible and improbable outcomes of vignettes from the biological, physical, psychological, and healing/illness domains (See Figure 1). Participants' data were examined using quantitative methods. Results suggested that, in certain cases, younger children utilize magic more as an explanation than older children and that children of all ages use magic as an explanation across all domains. These findings may have broader implications for science education as they provide a deeper understanding of children's conceptions of possibility.

Keywords: psychology, magical thinking, cognitive development, causal reasoning

Can Magic Make It Possible? An Examination of Age Differences in Children's Use of Magic as Explanatory Tool for Impossible and Improbable Outcomes

Introduction

Magical thinking, the belief that one's ideas, thoughts, or actions can influence events in the real world, shapes the thoughts and behavior of children (Shtulman & Morgan, 2017). Previous literature suggests that many children attribute fantastical causes to events that seem impossible in the real world, such as levitating a feather or stone (Hickling & Rosengren, 1994; Shtulman & Morgan, 2017). In the literature review, I will review how children's understanding of magic changes throughout early childhood and variability in magical thinking. Previous studies have examined children's use of magic to explain events that are physically-impossible such as a person walking through a solid brick wall. This exploration has also been limited to children's understanding of impossible events. Thus, this study extends existing literature by looking at (1) reasoning across multiple domains and (2) whether evaluations change between impossible and improbable events.

Literature Review

Magic is a phenomenon that is often portrayed in media targeted at children (e.g., Star Wars, Harry Potter, Snow White, Cinderella) and the common intuition that some events are "more impossible" than others is often captured in these fictional stories (Shtulman & Morgan, 2017). Outside of their experience with magic in media, children may use magic to explain "plausibly impossible" events that occur in their environment. Researchers as far back as Piaget have suggested that young children are prone to magical thinking and attribute human action as the cause of events from an early age (Phelps & Woolley, 1994). Furthermore, Phelps and Woolley (1994) argue that non-naturalistic belief systems such as beliefs in magic and magical thinking itself are

prevalent in young children and are used as an explanatory tool in the absence of scientific knowledge.

Children's ability to distinguish between fantasy and reality

Children are thought to be incapable of distinguishing between fantasy and reality; however, children are aware of the difference between fantasy and reality early in development and do not use magic as an explanation sporadically. Supporting evidence suggests that children do have a firm grasp of the distinction between fantasy and reality and can systematically distinguish fantasy from reality but are tempted to believe in the existence of what they have merely imagined (Harris, Brown, Marriott, Whittall, & Harmer, 1991). For example, Harris et al. (1991) examined children's understanding of pretense and reality in a series of two studies. To better understand children's thought processes when faced with an abrupt ending of an imaginary situation, the researchers used an experimental design that asked children to imagine a pretend creature was inside of a box and asked children to imagine a real animal such as a rabbit was in another box and then asked children to choose between the two. The findings of this research provide evidence that young children can distinguish between fantasy and reality and have the understanding that beliefs are not caused by reality, and reality is not directly influenced by fantasy. For example, when children imagine a creature such as a monster or rabbit in the box, they start to wonder whether the creature is in the box and cannot completely discount that possibility. Thus, children increasingly realize that beliefs may be causally disconnected from current reality and that their imagination can entertain fantasies that are disconnected from reality.

Moreover, understanding when and if children engage in pretense allows us to see if children how children manage the boundaries between fantasy and reality. The results of the two experiments conducted in the study by Golomb and Galasso (1995) indicate that preschoolers can maintain a clear distinction between pretend entities and real.

Children's beliefs in magic over the course of development

Growing evidence supports that children maintain various beliefs in magic. For example, existing literature suggests that children subscribe to beliefs about magical events and entities (e.g., Santa Claus, the Easter Bunny, and the Tooth Fairy) and over time, researchers have explored this psychological phenomenon (Phelps & Woolley, 1994; Woolley, 1997). Previous studies suggest that young children's beliefs are constrained by their knowledge and experience with the world. To assess this, Phelps & Woolley (1997) asked a set of interview questions to children ages 4-, 6-, and 8-years old. The results from this study show that children's willingness to consider an event magical may be related both to their understanding of several general physical principles normally operative in the world and to their knowledge of specific causal mechanisms. In essence, the studies support the hypothesis that children use magic when explaining events that violate their expectations and have no alternative explanations.

Research also suggests that children often recruit magic to explain things that could not happen in the real world. Researchers have examined children's use of magic to explain events by presenting them with events that directly violate the laws of physics or causal laws (e.g., showing a solid object passing through another solid object) (Chandler & Lalonde, 1994). An event that violates these causal laws or "violates a 'law of nature' and cannot occur in the real world" is considered to be impossible (Shtulman & Morgan,

2017, pg. 1573). For example, one study sought to examine when children invoked the notion of magic by showing one solid object passing through another solid object, violating the laws of physics. The results from this study provide evidence that children ages 3- to 4-years old are quick to invoke the notion of magic when evidence is put up against their knowledge of real-world rules (Chandler & Lalonde, 1994). Other research finds that 3- to 13- year-old children use magic as an explanatory tool when events violate their expectations about causal laws (Chandler & Lalonde, 1994; Phelps & Woolley, 1994).

Moreover, existing literature also suggests that younger children gave magical explanations more than older children after viewing the extraordinary events (e.g., magic tricks) (Rosengren & Hickling, 1994). These studies suggest that as children age and understand the world more, they rely less on magical thinking to explain the events they see. One reason why older children may be less likely to use magic as an explanation for impossible events is that they are better at understanding the difference between possibility and impossibility (Shtulman & Carey, 2007). Not only do children become more skeptical about magic as time goes on, but they also become more knowledgeable about events that can and cannot happen in the real world (Chandler & Lalonde 1994; Phelps & Woolley, 1994; Woolley, 1997).

There is evidence that there is variability amongst children in their magical beliefs given that some children are more predisposed to view magic as possible than others. In an investigation of magical beliefs in typically developing children through assessments of their predisposition to believe in magic based and their related habits and rituals, Evans and Milanak (2002) found that that children's compulsive rituals (i.e., avoiding

stepping on cracks, playing tag, or touching only alternate pickets in a fence) and physical explanations to various phenomena were positively related to their magical beliefs.

Another question to consider is whether there are differences in beliefs about fantasy between children and adults. Existing literature supports that children are able to make reality-nonreality distinctions, but does magical thinking change as people age? Woolley (1997) states that most adults have clear beliefs about basic casual relations between the mind and world. On the other hand, children are believed to think fantastically about the behavior and interactions between physical objects. One important distinction between children and adults is that children do resort to magical explanations and wishing whereas adults may not think this way at all. Other differences between magical thinking in children and adults are due to cultural context and domain-specific knowledge (e.g., knowledge of illness and health, laws of physics).

To further examine the behavior of children and adults towards possible and impossible events, Subbotsky (2010) conducted a series of four studies with 4-, 6-, 9-year-old children and adults to test the hypothesis that unusual events that violate real-world expectations (i.e., laws of physics) elicits curiosity and exploratory behavior of the supernatural. Participants were shown a wooden box and given either a supernatural explanation or scientific explanation for the objects inside the box. Results of the four studies suggest that children and adults alike are attracted towards phenomena that they view as impossible. Subbotsky suggests that one explanation for this is in a world dominated by science, impossible phenomena fill gaps in our minds. This work is important because it examines adults' use of magic and has implications for whether age

matters in regard to understanding the use of magic as an explanatory tool to describe phenomena.

Although magical thinking decreases with age, it does persist into adulthood. For example, adults tend to use magical thinking when their perception of control is lacking. Evidence of this includes those facing illnesses who may place unfounded importance on the power of attitudes or thoughts as a bridge to healing (Subbotsky, 2010). This is magical thinking since the thoughts themselves cannot directly change the situation (Woolley, 1997). Given that adults continue to engage in magical thinking reasoning related to certain domains (e.g., health and healing), it is important to research what real-world rule violations that children may be more likely to attribute to magic over the course of early childhood.

The present study

Examining children's magical reasoning across different domains. Previous studies have mainly examined children's use of magic to explain impossible events and in the physical domain (e.g., a solid object passing through another solid object). Children also have early developing naïve or "folk" theories about domains other than physics, such as biology and psychology (Gopnik, 2012). Do they use this folk understanding when evaluating violations of other domains? To our knowledge, not much is known about whether children apply magical explanations to domains outside of physics. One study investigated the effect that familiarity with a subject matter had on the type of casual explanations children use – naturalistic or non-naturalistic (Berzonsky, 1971). To better understand Piaget's theory of causality and his explanation of causal reasoning, the study presented children with questions dealing with three categories of

physical causality and two categories with causal demonstrations. Piaget's work postulated various stages or types of causal reasoning which a child will manifest regardless of the phenomenon in question. In order to test this hypothesis, Berzonsky interviewed 84 children to assess the children's concepts of physical causality (e.g., How does --- make --- happen?) (Berzonsky, 1971). The results from this study indicate that a child's familiarity with the objects or events they are being questioned about is a decisive factor in causal reasoning. In conclusion, these findings point to a possible source of variation in the results reported in the literature on child causality.

Another study that examined children's causal reasoning in the physical domain analyzed the influence of three factors on the responses of children to various questions regarding the physical domain – personality, experience, and question form (Nass, 1956). To investigate this, 120 children were asked to answer a series of questions (e.g., Why do the stars shine? How do the stars shine?). The results of the study uphold Piaget's hypothesis that the level of causal thinking in children may be influenced by experience with the underlying causal agent of a phenomenon (Berzonsky, 1971; Nass, 1956). Furthermore, the results suggest that the nature of children's causal thinking is affected by traits of personality, the wording of questions, and by the subject matter of the question.

To reiterate, there is not much known about when children utilize magic as an explanation outside of the physical domain. Other research suggests that children can also interpret the potentiality of events that violate biological, physical, psychological, or “healing” rules (see Figure 1) of the real-world these expectations (i.e., biological, physical, psychological, and “healing” rules) (Shtulman & Carey, 2017; Shtulman & Morgan, 2007). This research suggests that children believe some impossible events are

more possible than others based on their understanding of different “real world” laws across domains (Shtulman & Morgan, 2017). For example, children think that levitating a feather should be easier than levitating a stone. They seem to base their decisions about these magical events on their understanding of causal and physical constraints from the real world. In the previous example, children are applying the knowledge that a feather weighs less than a stone which therefore would make levitating the feather easier. This is intriguing because using magic to levitate any object is impossible, so levitating a feather and levitating a stone should be equally difficult. In other words, these real-world rules should not apply. Shtulman and Morgan (2017) found that children applied this reasoning for physical, biological, and psychological domains. The current study extends this work and examines children’s reasoning about magical causes for events in the biological, psychological, physical, and healing/illness domains.

Examining children’s magical reasoning across impossible and improbable outcomes. Based on existing literature, what is known about children’s distinction between impossible and improbable events focuses on how age influences this distinction. For example, when presented with an impossible event such as someone walking through a wall, younger children are most likely to attribute magic to the event. Older children are more likely to claim that the impossible event is a trick. This provides evidence that as age increases, the use of magic as an explanation decreases (Woolley, 1997). Previous studies have also been limited to impossible events, but it is possible that age-based trends might be based on differences in understanding of improbability. Shtulman and Carey (2007) investigated possibility judgements made by children ages 4- to 8-years old and found evidence that children deny the possibility of impossible events

and improbable events. Impossible events are those that violate causal laws, such as someone levitating a rock. Improbable events are those that are possible, but highly unlikely to occur such as finding an alligator underneath your bed. This study raises a few questions regarding when children make possibility judgements and in what domains they make these judgements about impossible and improbable events.

Hypotheses. In this study, I examined the impact of age, outcome type (impossible vs. improbable), and domain (physical, biological, illness, and psychological) on children's use of magic to explain events. Children were asked to evaluate a series of stories with either impossible or improbable endings and indicate whether they thought a magical object was necessary to make the outcome happen. I predicted that:

- (1) **Impact of age:** Younger children will utilize magic as an explanation more than older children.
- (2) **Impact of impossible vs. improbable outcomes:** Children will recruit magic more as an explanation for impossible events.
- (3) **Impact of domain:** Children will engage in magical reasoning across all domains.

Method

Participants

Data were collected from 16 participants ranging in age from 4 years of age to 10 years of age. Participants were recruited through social media posts on Facebook and Twitter.

Materials

Participants were told eight different stories (1 impossible story and 1 improbable story per each domain). The stories contained either an impossible outcome or

improbable outcome and the participants were asked to choose between a non-magic control action or a magical object. For this specific figure (Figure 1), children will be asked whether they think the protagonist in the story held the cracker in their hands or put the cracker in a magic box. The magical objects study script used throughout the study with participants on Zoom can be viewed in Appendix A. The pictures of the stories from the study that children were asked about can be found in Appendix B.

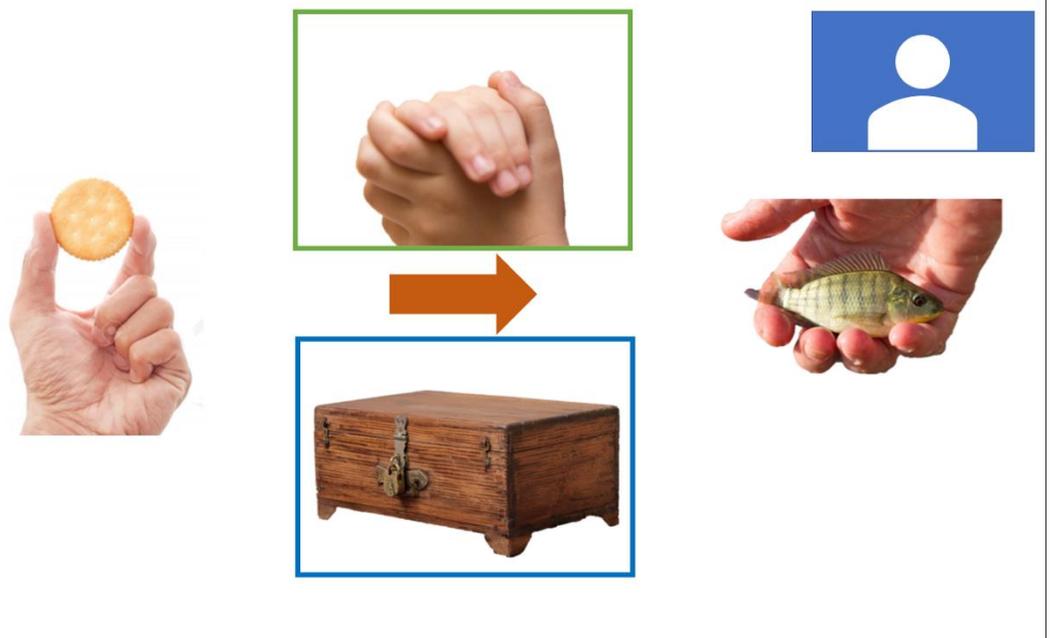


Figure 1. This is an example of a biological rule violation--a cracker turning into a fish.

Procedure

The study was conducted via Zoom software with participants. Participants were told eight total stories with impossible and improbable outcomes from the biological, physical, illness, and psychological domains. Children were told the beginning and end of each story and were asked to give input on what they thought happened in the middle of

the story. The experimenter would present two different options for what could have made an outcome occur. Children could choose between a magical object and a non-magical control action to let the experimenter know what they thought made the impossible or improbable outcome happen.

Measures

The measures in this study were the number of magical objects chosen by the participants.

1. Overall number of times magical objects were chosen (out of 8 total stories)
2. Split by impossible and improbable outcomes (out of 4 stories in each outcome type)
3. Split by domain (out of 2 stories for each of the 4 domains)

Results

Hypothesis 1: Impact of Age. An independent samples *t*-test was run to examine whether younger children and older children selected a different number of magical objects overall. The results of this study indicate that younger children (ages 4- to 6-year-olds) chose more magical objects on average than older children, $t(14) = 2.23$, $p = 0.042$. See Figure 2.

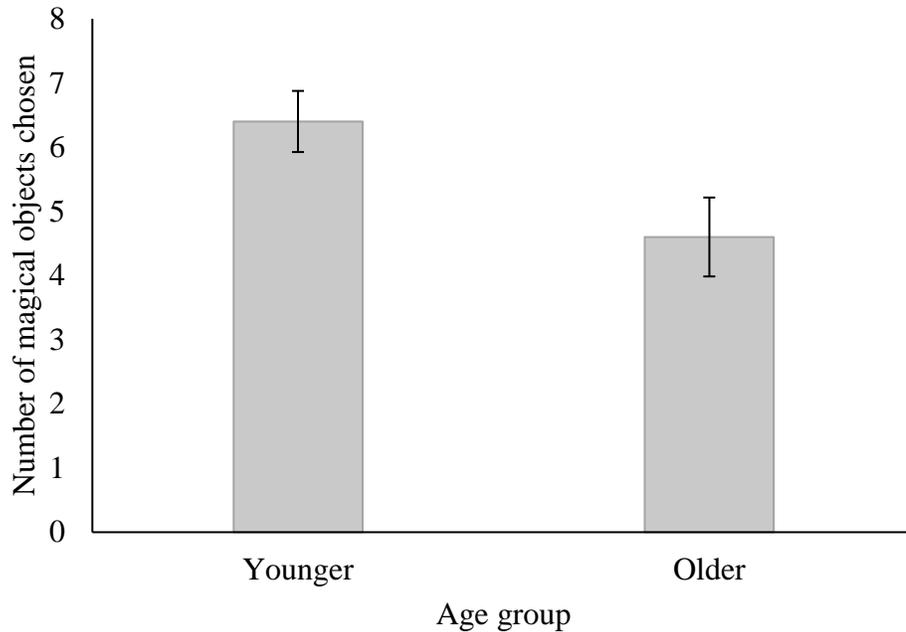


Figure 2. Mean number of magical objects chosen by younger and older children. Error bars represent 1 standard error of the mean.

Hypothesis 2: Impact of impossible vs. improbable outcomes. A paired-samples *t*-test was run to examine whether children chose magical objects at different rates for impossible versus improbable outcomes. There were no significant differences in participants choosing magical objects to explain impossible or improbable events, $t(15) = -.044, p = 0.069$. See Figure 3.

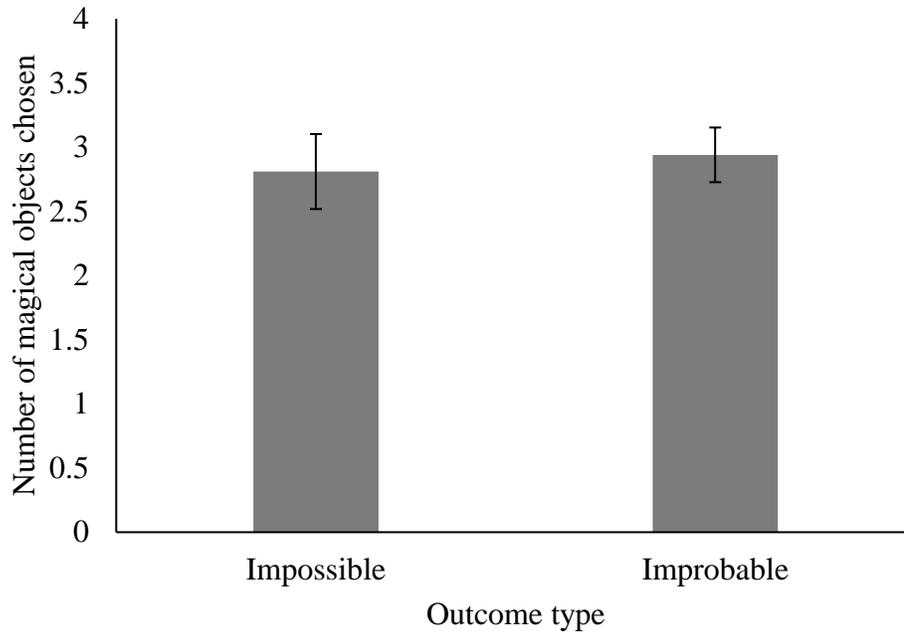


Figure 3. Mean number of magical objects chosen in each story outcome type. Error bars represent 1 standard error of the mean.

Hypothesis 3: Impact of domain. A repeated measure ANOVA was run to examine the impact of domain (4: biological, psychological, physical, illness) on children's selections of magical objects to explain the outcome, controlling for age. There was not a significant effect of domain, $F(6, 10) = .137, p = .389$; Wilk's $\Lambda = 0.0967$ (see Figure 4).

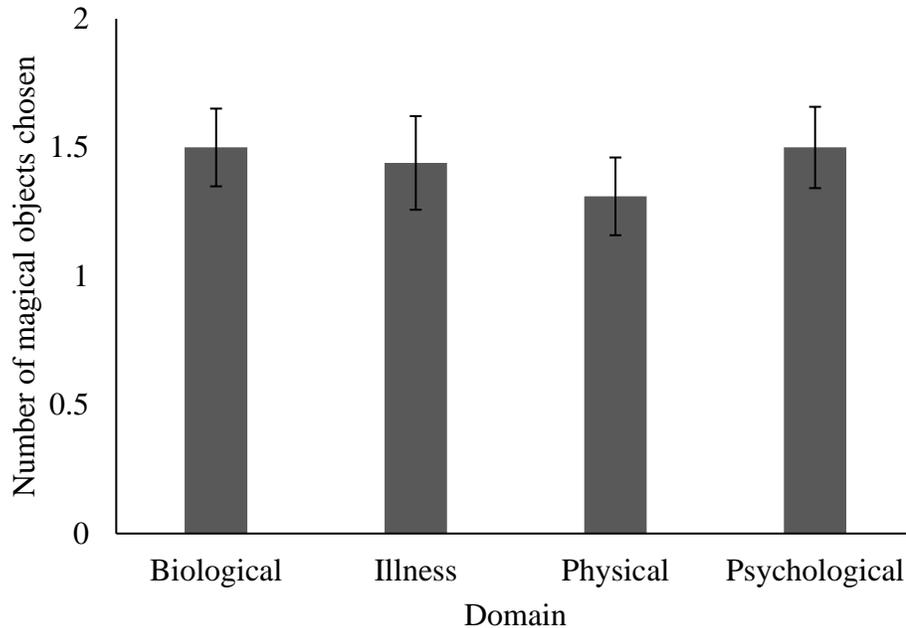


Figure 4. Mean number of magical objects chosen per domain type. Error bars represent 1 standard error of the mean.

Discussion

There is still more to discover about children’s use of magic as explanatory tool for impossible and improbable outcomes. Due to a small sample size, it is difficult to make generalizations based on the preliminary data.

Impact of age. Existing literature that younger children use magic as an explanation more than older children (Rosengren & Hickling, 1994) supports the hypothesis that younger children would utilize magic more than older children in the impossible and improbable stories. The results from the preliminary data are in line with what the literature suggests as younger children chose magical objects during the stories more than older children.

Impact of impossible versus improbable outcomes. The hypothesis that children would use magic more to explain the impossible events is supported by the

existing literature that examined in what situations children magic. For example, Woolley (1997) provides evidence that children are more likely to resort to magic as an explanation compared to adults. The results were not statistically significant and do not provide support for the hypothesis that children will use magic to explain impossible events more than improbable events. This may have occurred because children were given the choice between a non-magic control action and a magical object when told the stories. However, these options did not relate to the impossible or improbable outcome in the story.

Impact of domain. Based on existing literature, it was expected that children would use magic to explain outcomes in the physical domain (Berzonsky, 1971). This thesis project was an attempt to answer the question of how children use magic as an explanatory tool in impossible and improbable outcomes, and whether age has an impact on the use of magic as an explanatory tool. Rather than focusing on the physical domain (Shtulman & Carey, 2017), this thesis explored the physical, biological, illness, and psychological domains. Based on previous literature it is predicted that as age increases, the use of magic as an explanation decreases (Woolley, 1997).

Limitations

There are a few limitations in this study that could be addressed in future research. The greatest limitation in this research was the COVID-19 pandemic as it impacted the ability to conduct in-person interviews with participants and altered the layout of the study. Prior to the pandemic, similar studies were conducted in person with paper stimuli. This study was conducted using the virtual platform, Zoom, and a PowerPoint with the eight stories laid out. Although having the study online made it more

accessible to people outside of Central Texas, there was still limited participation.

Children also seemed to struggle with portions of the online study as they would point to their computer screen when researchers could not view what they were pointing to. In addition to this, the diversity of the sample may have been limited as not everyone has access to the internet and may not have been able to participate in the study.

Another limitation to the study is that open-ended questions were not asked about children's choices in each story. Future studies could incorporate more direct questions about why children chose or did not choose a magical object. Other questions could also ask about children's general beliefs in magic. The answers to these questions could inform researchers about children's causal reasoning and provide explanations about the developmental trajectory of magical thinking. Children's explanations to these questions could also provide insight into the testimony that they receive from parents about magic.

Finally, when making their choice in the stories, children could only choose between a non-magical action or a magical object to explain each outcome. There are two elements that do not match between the choices (1) the presence of an object, (2) presence of magic. Instead of providing these two choices, future studies might include two similar objects, one with magical properties and the other a non-magic object.

Future Directions

The current study had a diverse sample of participants, but it was not large enough to be generalizable. Future studies should also investigate the role that culture may play in the development of children's magical beliefs. The majority of literature examining children's use of magic as an explanatory tool has assessed the beliefs of children from predominantly Euro-American backgrounds (Hickling & Rosengren, 1994; Phelps &

Woolley, 1994; Chandler & Lalonde, 1994; Woolley, 1997). In contrast to the lack of belief in magic typical in Euro-American cultures, some Central and South American communities incorporate magic as a part of their daily practices and beliefs. Some of these practices and beliefs include *ojo* (evil eye beliefs), *curanderos* (healers and remedies), and *brujeria* (witchcraft) (Subbotsky & Quinteros, 2002; Legare et al., 2012;). These cultural traditions are a pervasive feature of many Latinx children's lives and may have implications for their use of magic as an explanatory tool, such that Latinx children will be more likely to use magical explanations for more events than their Euro-American peers. As previously mentioned, many Latinx children are exposed to magic as a credible explanation for different events and outcomes through cultural practices. Future studies may investigate children's exposure to magic as Euro-American children do not have the same exposure to magic that Latinx children experience and may give less credit to magic as an explanation for impossible and improbable outcomes.

Conclusion

This study investigated the intersection of children's reasoning about whether magical objects help make impossible and improbable events occur. Overall, the difference in responses between younger and older children were the most interesting as their answers upheld the suggestion that as age increases, the use of magic as an explanation decreases. Some of the responses confirmed the study hypotheses that younger children use magic more to explain impossible and improbable outcomes, and that children of any age will use magic to explain events across all domains. These findings, while data collection is on-going, give an interesting perspective of the impact of age on children's use of magic as an explanatory tool in stories with impossible and improbable outcomes.

Understanding children's causal reasoning may also have importance in learning more about how children learn about the world through testimony from sources such as media, parents, and peers. This study and its results have implications in different lines of work pertaining to science education and children's understanding of complex topics such as evolution and natural selection.

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Appendix A

Magical Objects Study Script

Introduction

Hello! Thank you to you both for being here today. My name is _____ and I am a researcher in the Learning in Context Lab.

Okay, child's name, to get things started, I'm going to talk with your adult first.

[Share powerpoint screen]

Do you see a white screen of a PowerPoint? Great!

Consent

Before the study, we emailed you a copy of the consent form. Can you confirm that you received a copy of the consent form?

[If no, share a copy of the consent form on the screen.] I am going to share the consent form on your screen now. Please take as long as you need to read through and let me know if you have any questions.

[If yes or once the consent form has been reviewed via screen-share on Zoom] Do you have any questions for me about the information in the consent form?

[If no or once questions are answered] Your verbal consent will replace your signature on the consent form. To provide verbal consent, I will need you to read the statement currently on the screen, replacing the bracketed text with the relevant information. Keep in mind that by default, the study will be recorded so that we can keep track of your child's answers, but you also have the option of providing consent for Level 2 use of the recording so that it can be shared for educational purposes in classes and at conferences.

The screen will read: Today is [DATE]. My name is [NAME]. I have read the consent form provided and I give consent for my child [CHILD'S NAME] to participate in the study. I understand that I or my child may stop participation at any time and that the study session will be recorded.

[Optional] I give consent for Level 2 of video consent as described above.

Game Set-Up

Now I just need your help for a couple of minutes to set up the game.

So now we're going to go through a few steps to get your screen all set up for the game. So first you happen to know what device you're using? laptop, desktop Mac, PC? And this might have already happened already kind of automatically when I

shared my screen with you - but are you in full screen mode or can you see other applications on your screen?

Okay, great, and are our videos floating on top of the screen like this image over here, or are they beside the screen and inside a black border? If you click on our videos, can you drag them to different places on the screen? *If beside:* click “view options and uncheck the box that says “side by side” view. Okay, great. So now they're on top, which is awesome.

And can you see just me, or can you see my video and your video, [plus our non video participants here today]? So first we'll have you hide your video. So if you just hover over these blue dots here and select “hide self” over your video, that would be great.

[hide non-video participants instructions] Now under view, you should be able to select “Hide non-video participants” - Great!

And so last I'll just have you move my video to this square on the screen. Okay, great.

[to parent] One last thing! You're welcome to stay with ____ throughout the game, but we just ask that during the game, you don't respond to anything that's happening on the screen and don't attempt to answer any questions, so we can just get a sense of what happens without your input. But at the end of the game if you have any questions, I'm happy to answer them. Does that sound okay to you?

So we are all ready! [Child's name] you have been so patient, thank you for waiting. Are you ready to get started?

Assent

Okay [child's name] - How old are you?

If 6 or under:

I want to tell you about some games we are going to be playing.

During these games, I am going to tell you some stories and ask you some questions. There are no right or wrong answers to anything I ask!

There are a few things you should know about the games:

- You get to decide if you want to play the games
- Whatever you decide is OK
- If you say ‘Yes’ now, you can change your mind and say ‘No’ later
- You can ask questions at any time.

Okay – now I'm going to ask you a question. Do you want to play some of my games?

If 7 or older:

I want to tell you about a research study I am doing.

Research studies help us to learn new things and test new ideas.

People who work on research studies are called researchers.

During research studies, the researchers collect a lot of information so that they can learn more about something. I am a researcher and I am doing this study because I would like to know more about how children think about the world.

During this study, I am going to tell you some stories and ask you some questions. There are no right or wrong answers to anything I ask!

There are a few things you should know about this study:

- You get to decide if you want to be in the study
- Whatever you decide is OK
- If you say ‘Yes’ now, you can change your mind and say ‘No’ later
- You can ask me or the other researchers questions at any time.

Okay – now I’m going to ask you a question. Do you want to be a part of this study and help me learn more about how children like you learn?

Warm-up Pt. 1 (Introduce Elmo scale)

Thank you for playing my game with me today. Before we get started, I would like to practice a little bit.

For some of the questions I am going to ask you, you might be very sure about, like the green Elmo, and some questions you might not be sure at all about, like the red Elmo, and I am going to use these pictures for you to tell us.

Over here we have a picture of a red Elmo and he is not sure at all, and in the middle, we have a picture of yellow Elmo and he is not so sure, and over here we have a picture of green Elmo and he is very sure. These are pictures that you can use to tell me how sure you are about things. I want you to pick red Elmo if you are not sure at all. I want you to pick yellow Elmo if you are not so sure. I want you to pick green Elmo if you are very sure.

Let’s practice with these pictures. I am going to ask you a few questions. Are you ready to practice? Okay, let’s get started.

(sky slide)

What color is the sky in this picture? **[wait for child response]** Okay, are you not sure at all like red Elmo, not so sure like yellow Elmo, or very sure like green Elmo? **[repeat if child is unclear]**

Great job! So you are [insert child's answer] that the sky is blue/not blue.

(jellybeans slide)

Now, look at this jar of jelly beans. How many jelly beans do you think are in the jar? **[wait for child response]** Okay, so are you not sure at all like red Elmo, not so sure like yellow Elmo, or very sure like green Elmo about how many jelly beans you think are in the jar? **[repeat if child is unclear]**

Great job! So you are [insert child's answer] that you there are [x] of jelly beans in the jar.

Warm-up Pt. 2 (Green box/Blue box)

Now we are going to play a new game. When I ask you questions, I am going to give you two options. One of the options will be in a green box, and the other will be in a blue box. When you tell me your answer you can tell me the green box or blue box, OR you can tell me what's in the box. Are you ready to practice?

(cupcake/broccoli slide)

1. Which one of these foods do you like more? Do you like cupcakes in the green box or do you like the broccoli in the blue box? How sure are you?

(monster slide)

2. Which one of these monsters is red? Is it the monster in the green box or in the blue box? How sure are you?

Warm-up Pt. 3 (Practice story)

When we play the game we are going to listen to some stories. I will tell you the beginning and the end, and I want you to tell me what happens in the middle of the story.

(Sally's red balloon slides)

Here is Sally's red balloon.

Something popped Sally's red balloon.

There are two things that could have happened.

The hedgehog could have popped it with its quills

OR

The tree could have popped it with its branches

What do you think popped Sally's red balloon? Was it the hedgehog's quills OR was it the tree's branches?

How sure are you?

VIGNETTES

Physical Impossible Vignette 1

Jessica wanted to make a piece of paper float above a table.

Jessica did something special that made the paper float.

There are two things Jessica could have done.

Jessica could have waved her arm

OR

she could have waved a magic wand.

What do you think Jessica did to make the piece of paper float above the table? Did she wave her arm OR did she wave a magic wand?

Are you not sure at all, not so sure, or very sure?

Illness Improbable Vignette 2

Julian's mom was very sick and he wanted her to get better.

Julian did something special to make his mom better.

Julian could have done two things to make his mom better.

Julian could have pinched his fingers together

OR

He could have rubbed two magic leaves together.

What do you think Julian did? Did he pinch his fingers OR did he rub two magic leaves together?

Are you not sure at all, not so sure, or very sure?

Physical Improbable Vignette 2

Kate wanted to change an ice cube into water quickly.

Kate did something special that made an ice cube into water in a few moments.

There are two things Kate could have done.

She could have clapped her hands

OR

She could have put on magic gloves.

What do you think Kate did to change the ice cube into water?

Did she clap her hands OR did she put on magic gloves?

Are you not sure at all, not so sure, or very sure?

Biological Improbable Vignette 2

Lola wanted to help her gecko's tail grow back.

Lola did something special that made her gecko's tail grow back.

There are two things Lola could have done.

Lola could have snapped her fingers

OR

She could have sprinkled magic dust.

What do you think Lola did to help her gecko's tail grow back? Did she snap her fingers OR did she sprinkle magic dust?

Are you not sure at all, not so sure, or very sure?

Psychological Impossible Vignette 2

Lily wanted her turtle to sing.

Lily did something special that made her turtle sing.

There are two things Lily could have done.

Lily could have picked up her turtle

OR

She could have put her turtle in magic water.

What do you think Lily did, did she pick up her turtle

OR did she put her turtle in magic water?

How sure are you?

Psychological Improbable Vignette 1

Isabel wanted her parrot to speak.

Isabel did something special that made her parrot speak.

There are two things Isabel could have done.

She could have blinked her eyes

OR

She could have put on a magic mask.

What do you think Isabel did to make her parrot speak?

Did she blink her eyes OR did she put on a magic mask?

Are you not sure at all, not so sure, or very sure?

Biological Impossible Vignette 1

Bryce wanted to turn a cracker into a fish.

Bryce did something special to change the fish.

Bryce could have done two things.

Bryce could have put the cracker in his hands and shook it

OR

He could have put the cracker in a magic box and shook it.

What do you think Bryce did, did he put the cracker in his hands and shake it OR did he put the cracker in a magic box and shake it?

Are you not sure at all, not so sure, or very sure?

Illness Impossible Vignette 1

Sasha's dad does not have a foot.

Sasha wanted to help her dad grow back his foot.

Sasha did something special that helped her dad grow back his foot.

There are two things Sasha could have done.

She could have slid her foot on the ground

OR

She could have stood on a magic carpet.

What do you think Sasha did to help her dad grow back his foot? Did she slide her foot on the ground OR did she stand on a magic carpet?

Are you not sure at all, not so sure, or very sure?

Survey (Click on Qualtrics link in PowerPoint)

Now we are going to take a quick survey, so the screen sharing might look a bit different.

Possibility — “Have you ever seen...”

- Someone eating pickle flavored ice cream
- Someone paint dots onto an airplane
- Someone travel in time
- Someone walk through a wall
- Someone grow a beard to their toes
- Someone eat lightning for dinner
- Someone walk on water
- Someone find an alligator under their bed
- Someone turn applesauce back into an apple
- Someone drink onion juice

If “no” ask, “could a person ____ in real life?” and then “why couldn’t a person ____ in real life?”

If “yes” go to next picture

We’re all done with the games now!

Debriefing script

We are finished with the research (7-year-olds+)/the games (under 7) now!

Before you go, I want to share a bit about the stories and questions I was asking. I also want to give you a chance to ask me some questions.

I am a scientist that studies what kids think and how they learn. Another word for the kind of science that I do is called psychology. Psychology means the study of thinking, learning, and behavior.

Do you remember earlier when I was telling you some of those stories and asking you what happened in the middle? I was doing that so I could learn more about what kids think causes things to happen. I am asking a whole bunch of kids about those stories and one day I’ll look and see if everyone answers the same or not. This is something that scientists do in psychology – they ask lots of people questions to see if they say the same or different things.

Did you think any of the stories were really silly? Did you have a favorite story?

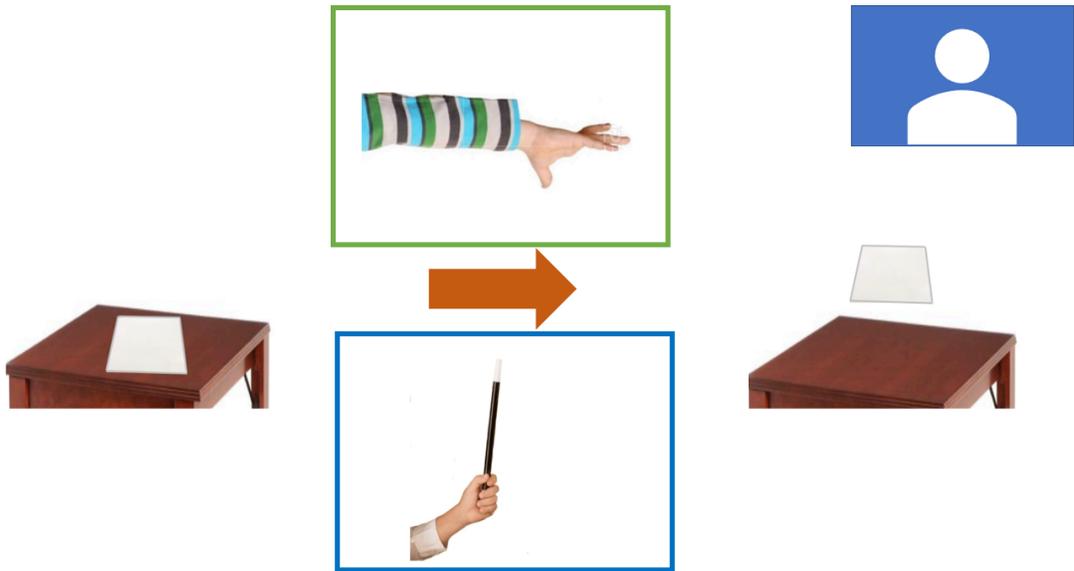
Do you have any questions for me about the stories? What about any questions about being a scientist or doing psychology?

[Address the parent] – Do you have any questions for me about the study?

Appendix B

Magical Objects Study Vignette Pictures

1. Physical Impossible Vignette 1



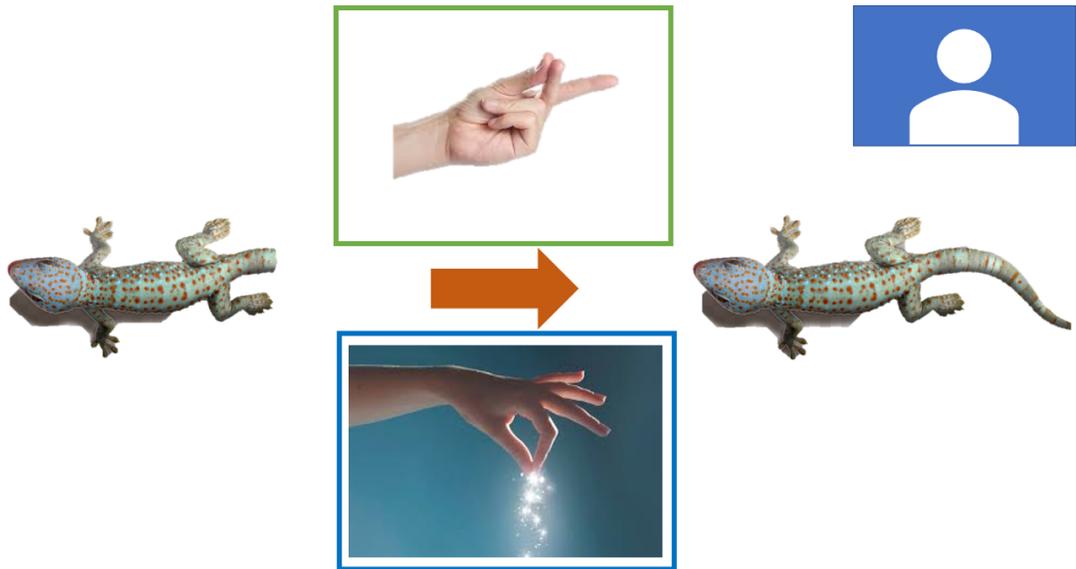
2. Illness Improbable Vignette 2



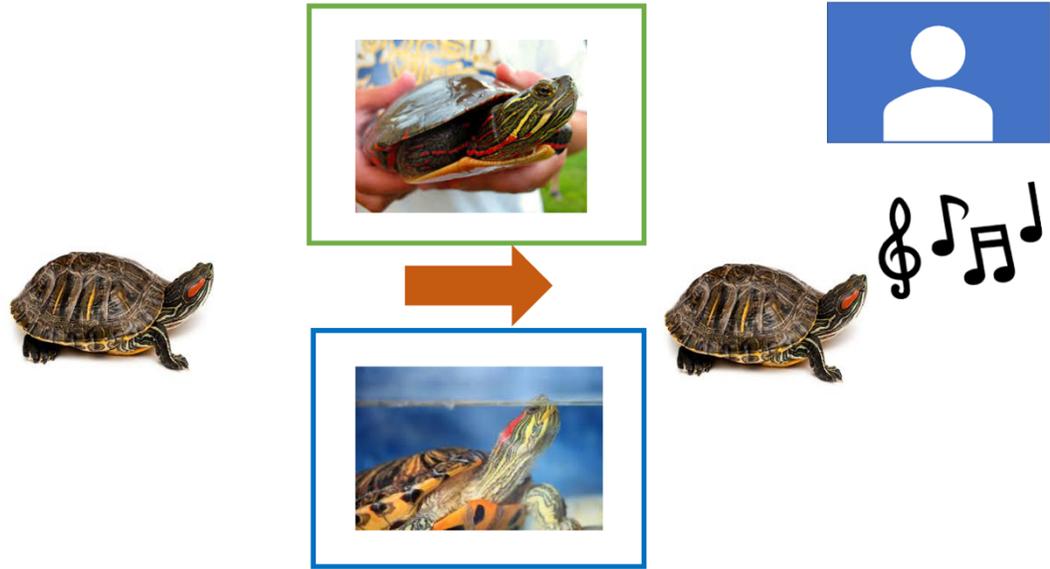
3. Physical Improbable Vignette 2



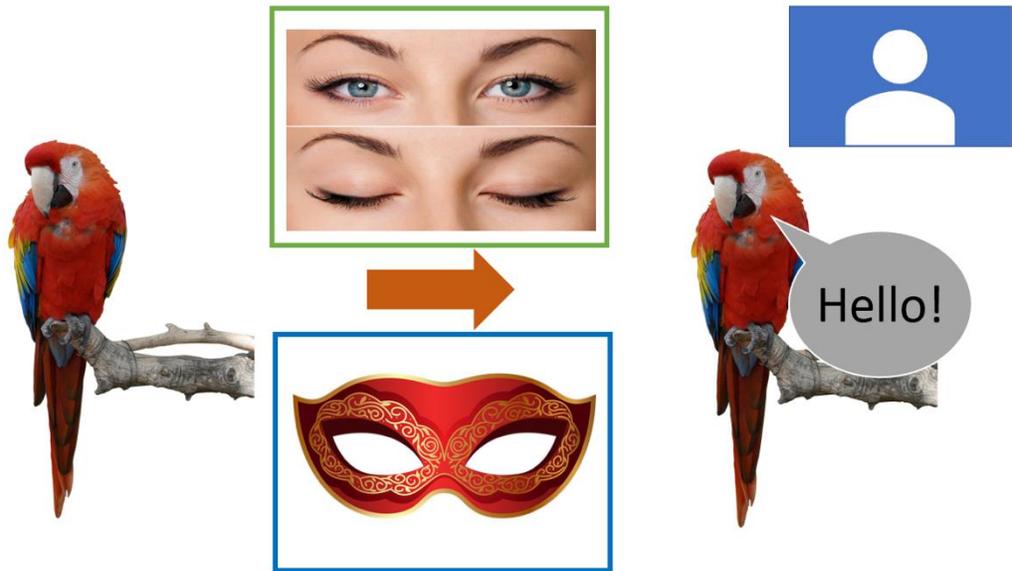
4. Biological Improbable Vignette 2



5. Psychological Impossible Vignette 2



6. Psychological Improbable Vignette 1



7. Biological Impossible Vignette 1



8. Illness Impossible Vignette 1

