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## Children's belief in purported events: When claims reference hearsay, books, or the internet

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### ABSTRACT

Children aged 4.75–8.50 years ( $n = 127$ ) heard testimony about improbable or impossible events—referencing either spoken hearsay, a book, or the internet—and judged whether the events could occur in reality. A separate baseline group ( $n = 48$ ) judged the events without hearing testimony. Relative to baseline, younger children (4 and 5 years) reported greater belief that improbable events could occur when testimony referenced hearsay and less belief when testimony referenced the internet. In contrast, older children (8 years) were less likely to believe improbable events could occur when testimony referenced hearsay and believed testimony that referenced a text-based source (a book or the internet) at rates similar to baseline. Beliefs about the occurrence of impossible events were similar (and low) across ages and testimony conditions. Implications for children's learning from spoken and text-based sources are discussed.

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### Introduction

Although the spread of false information has always been a problem, the internet and social media support the proliferation of false information at an unprecedented rate because they are inexpensive, are widely accessible, and reach large audiences (Waldrop, 2017). Adults consider many factors when evaluating information on the internet (e.g., Pennycook, Cannon, & Rand, 2018). Yet, both adults and

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children are vulnerable to misinformation obtained from the internet and other sources, including misinformation transmitted via spoken word and printed text. Despite the risks in trusting these sources, children and adults *must* rely on these sources, rather than firsthand experience or observation, to learn about many aspects of the world. In particular, we often encounter information about unusual, counterintuitive, or extraordinary events via others' claims, and these claims may be difficult or impossible to personally verify. Moreover, the people who transmit this information may have *themselves not personally witnessed* the events; thus, their claims are secondhand. For example, adults may tell children about events that occurred in distant locations or that took place centuries ago without having witnessed those events themselves. Here, we explored how children's beliefs about purported improbable and impossible events are influenced by secondhand testimony that the events occurred, in particular testimony that references either spoken claims or text-based sources. Furthermore, we examined potential differences in children's judgments based on whether the text came from a book or the internet.

Like adults, children account for many factors when evaluating people's claims. When evaluating the reality status of novel or counterintuitive statements, children as young as 5 years consider how the content fits with their prior knowledge (e.g., [Chan & Tardif, 2013](#); [Lopez-Mobilia & Woolley, 2016](#); see also [Lane, 2018](#)) and whether the person providing information has relevant expertise (e.g., [Lane & Harris, 2015](#)). Children are also attentive to speakers' use of evidentials, linguistic markers that indicate how a piece of evidence was acquired (e.g., via direct perception or inference; [Fitneva, 2008](#); see also [Fitneva, 2018](#)). Children older than 6 years are sensitive to whether evidence is based on firsthand or secondhand observation. Specifically, they show diminished belief in purported improbable events prefaced with the evidential statement "someone told me...," which indicates that the statement is based on secondhand information (i.e., hearsay; [Lane, Ronfard, & El-Sherif, 2018](#)). Conversely, children younger than 6 years are *more* likely to believe testimony referencing hearsay than firsthand observation, potentially because they interpret hearsay as evidence of consensus (see [Corriveau, Fusaro, & Harris, 2009](#)). The current study assessed the robustness of and boundary conditions for the effects of secondhand claims by examining judgments of testimony referencing spoken hearsay as well as book, and internet sources.

### *Trust in books and the internet*

Text comes in many forms, including books, magazines, newspapers, blogs, and Wikipedia articles, and belief in text-based claims could conceivably vary across these sources, even during childhood. In the current study, we focused on two text-based sources: books and the internet. Books are a primary means of conveying information during the elementary school years and beyond. Prior work indicates that when children choose between learning from spoken labels or labels printed on paper, they prefer the text-based labels (e.g., [Corriveau, Einav, Robinson, & Harris, 2014](#); [Einav, Rydland, Grøver, Robinson, & Harris, 2018](#)), but this preference does not necessarily extend to other text-based materials such as books. Children as young as 3 years realize that the information in books may be inaccurate ([Vanderbilt, Ochoa, & Heilbrun, 2018](#)), and young children sometimes show inordinate skepticism toward the content of books. For example, when presented with realistic storybooks, children aged 3 and 4 years often indicate that the events described in the books could not happen ([Woolley & Cox, 2007](#)). Importantly, as they develop and gain experience in using books as information sources, children's belief in claims that reference books may change as well.

Books have long been a popular text-based source of information and entertainment for children in most industrialized countries, yet the internet is quickly becoming an equally, if not more, ubiquitous information source. Indeed, 98% of American children under 8 years of age have devices that can access the internet, and on average they spend more than an hour a day using these devices ([Rideout, 2017](#)). Moreover, parents often consult the internet when answering their children's questions ([Mills, Danovitch, Sands, & Williams, 2019](#)). Understanding how children treat claims that reference the internet is important for practical reasons and as a means of gaining insight into their thinking about different forms of text-based sources.

Like a book, the internet is a largely text-based repository of information. However, unlike most books, internet sites might not identify an author or original source. The internet is also more inter-

active than a book, and it can include pictures, sounds, and/or videos to supplement the text. Children's attitude toward information acquired from the internet is likely to change over development. For instance, preschoolers who are familiar with devices such as tablets and smartphones do not identify them as means of learning and, unlike adults, they indicate that books are better than technological devices for obtaining information (Eisen & Lillard, 2017). Elementary school-age children are often more familiar with the internet, but they still might not consider the internet an information source, and they are generally incapable of using it to find information (Dodge, Husain, & Duke, 2011). Recent findings also suggest that children aged 4–6 years prefer human informants over internet-based sources (Danovitch, Noles, & Shafto, 2016; Wang, Tong, & Danovitch, 2019). A shift appears to occur at around 8 years of age, when children begin to prefer information originating from the internet over information obtained from other people. Importantly, in prior studies, children simultaneously evaluated pairs of contradictory statements from a person versus the internet. The current study presents information in a way that children are more likely to encounter it in their everyday lives—as single improbable statements (e.g., “someone drank onion juice”) or impossible statements (e.g., “someone turned an onion into a banana”) that reference a source. Thus, children must evaluate the reality status of claims based on their content and the nature of the information source rather than weighing the relative status of multiple sources.

### *Study design and hypotheses*

The current study included children aged 4.75–8.50 years. Children's belief in the potential occurrence of improbable events increases across this age range but remains lower than adults' levels of belief, whereas their disbelief in impossible events remains relatively strong and stable (Shtulman & Carey, 2007). This age range also encompasses a period during which children develop reading skills, gain exposure to a wider variety of books, and become more familiar with the internet. We employ a between-participants design where children hear testimony referencing a single source (i.e., spoken hearsay, a book, or the internet) or no source (i.e., Baseline condition). Our Baseline condition establishes whether children in the current sample respond similarly to children drawn from other populations (e.g., Shtulman, 2009; Lane, Ronfard, Francioli, & Harris, 2016; Lane et al., 2018), and it provides a comparison point for children in each testimony condition.

Based on Lane et al.'s (2018) findings, we expected that children aged 4 and 5 years who are provided with spoken hearsay would believe that improbable events could really occur more often than children in the Baseline condition, and that children over 6 years who are provided with spoken hearsay would less often believe that such events can occur. Our predictions for the Book and Internet conditions were less firm because prior research has not directly evaluated children's independent belief in extraordinary claims purportedly sourced from books or the internet. We predicted that younger children (4 and 5 years) in the Book condition would express relatively strong belief in purported improbable events (relative to baseline)—because they might consider text-based sources as generally reliable—and that their acceptance of claims from these sources would remain strong into middle childhood. Based on evidence that young children are skeptical of technological information sources (see Danovitch, 2019, for a review), we expected younger children in the Internet condition to be skeptical of claims about improbable events attributed to an internet source (relative to hearsay or baseline) and expected older children to be more accepting of such claims. We anticipated that children's beliefs about impossible events would be similar regardless of the information source (e.g., Lane et al., 2018).

## **Method**

### *Participants*

Participants were 175 children aged 4.75–8.50 years ( $M = 6.63$  years; 86 boys and 89 girls) from Louisville, Kentucky, a large city in the southern United States. This sample size allowed us to detect effects that were small–medium or larger for individual coefficients in our focal regression analyses

(specifically,  $f^2_s \geq .0454$ , where .02 is small and .15 is medium, according to Cohen, 1992), with power = .80 and  $\alpha = .05$ . Power analyses were computed using G\*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). An additional 3 children were not included in data analysis; two because of experimenter error and one because the child refused to complete the task. Of the 175 participants, 37 ( $M_{\text{age}} = 6.58$  years) were assigned to the Hearsay condition, 43 ( $M_{\text{age}} = 6.62$  years) were assigned to the Book condition, 47 ( $M_{\text{age}} = 6.67$  years) were assigned to the Internet condition, and 48 ( $M_{\text{age}} = 6.66$  years) were assigned to the Baseline condition. The youngest children (4.75–6.59 years) were relatively evenly distributed across the four conditions (ranging from 21% to 30% per condition), and the oldest children (6.60–8.50 years) were also evenly distributed across conditions (22% to 28% per condition). According to parental reports, 92% of children were non-Hispanic and 3% were Hispanic (parents of the other 5% chose to not answer this question). Approximately 85% were identified as Caucasian American, 6% as African American, 2% as Asian American, and 6% as belonging to two or more ethnic groups (1% of parents chose to not answer this question). Children were interviewed individually at their school or in a laboratory setting, in a session lasting approximately 10 min. Participant recruitment, consent, and study procedures were approved by the University of Louisville institutional review board.

### *Stimuli and procedure*

The procedure was based closely on Lane et al. (2018). Children were randomly assigned to one of four conditions. In the Hearsay, Book, and Internet conditions, the experimenter began by stating that she was “trying to figure out whether different things can happen in real life” and that she had asked some people whether those things could happen. Children were told that they would watch videos showing the people’s answers and that after each video they would be asked whether the event could really happen. For children in the Hearsay condition, the experimenter prefaced the videos by stating, “In these next videos, the people are going to tell us about things that *other people told them*.” The last four words were replaced with “they read in a book” in the Book condition and with “they read on the internet” in the Internet condition.<sup>1</sup>

Children watched a total of eight videos. In each video, an informant seated at a table made a statement about an event. In the Hearsay condition, the statement was phrased, “Someone told me that a person [completed an improbable or impossible activity].” In the Book condition, the statement was phrased, “I read in a book that a person [completed activity].” In the Internet condition, the statement was phrased, “I read on the internet that a person [completed activity].” All informants were blond-haired, European American women in their early 20’s wearing plain black shirts. Each video lasted approximately 5 s.

After watching each video, children were asked, “What do you think? Could a person [complete activity described in video] in real life or not?” The experimenter then repeated children’s choice (e.g., “Okay, you think that a person could/could not [complete activity] in real life”) and asked children to indicate their confidence: “Are you very sure or just a little sure?”

Children viewed two blocks of four videos each. In one block, the videos presented four different informants making statements about impossible events (four events total, drawn from a pool of eight events; see Appendix A). In the other block, the same four informants made statements about improbable events (four events total, drawn from a pool of eight events; see Appendix A). The order of the blocks and events was counterbalanced between participants.

In the Baseline condition, children were not shown videos. After stating that she was trying to figure out whether different things could happen in real life (as in Lane et al., 2018), the experimenter asked about each of four improbable events and four impossible events in the form of “I wonder if someone could [complete activity].” Children then indicated whether they thought each event could happen in real life and their confidence. The order of the blocks and statements mirrored the orders used in the other conditions.

<sup>1</sup> Children in the Internet condition completed up to two additional check questions probing their familiarity with the internet, and their responses indicated that they were familiar with the internet (see supplementary material for details).

## Scoring

Following from Lane et al. (2018), responses to the reality and confidence questions were converted to numerical values, such that 0 = very sure that the event could not happen, .334 = a little sure that the event could not happen, .667 = a little sure that the event could happen, and 1.00 = very sure that the event could happen. An Improbable Events composite and an Impossible Events composite were calculated by averaging across the four items in each category. This yielded two continuous variables, each ranging from 0 to 1.00.

## Results

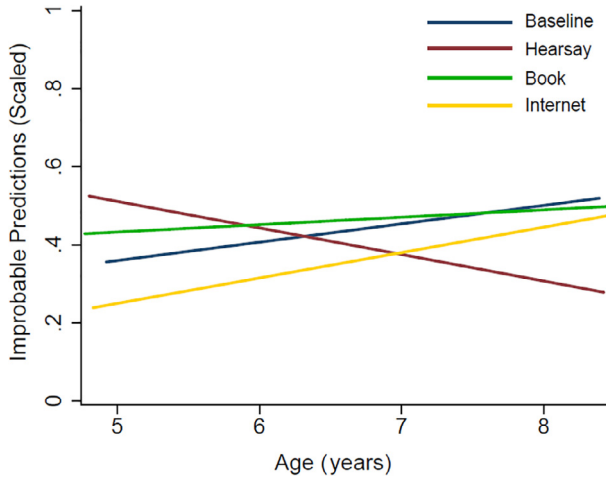
We expected that effects of condition and developmental trends would differ for improbable and impossible events. Thus, an initial multilevel mixed-effects regression (see Table S1 in [supplementary material](#)) examined whether age-related trends in belief and effects of condition differed when participants reasoned about improbable events versus impossible events. These analyses revealed multiple interaction effects involving event probability (i.e., improbable vs. impossible), including significant interactions of Event Probability  $\times$  Age and Event Probability  $\times$  Condition  $\times$  Age; that is, the interaction of Event Probability  $\times$  Age differed between the sources. Given different trends found for the improbable and impossible events, subsequent analyses examined participants' beliefs about purported improbable events and purported impossible events separately. All analyses were conducted with Stata 14 (Stata Corp., College Station, TX, USA).

### *Improbable events*

Children's beliefs in the likelihood of improbable events were explored with regression analyses that included age as a continuous variable, source as three dummy-coded variables (hearsay, book, and internet), and interactions between source and age; the Baseline condition served as the comparison condition (see Table S2 in [supplementary material](#) for descriptive data). [Fig. 1](#) presents the resulting fitted regression lines depicting age-related trends for children in each of the four conditions. This analysis (see [Table 1](#)) revealed a significant interaction of Hearsay  $\times$  Age. The age-related decrease in belief among children who heard hearsay differed significantly from the age-related increase in belief among children in the baseline group. Lack of other significant Condition  $\times$  Age interactions indicates that age-related trends among children in the Book and Internet conditions paralleled the trend in the Baseline condition. (An ordinal logistic regression yielded identical results; see Table S3 in [supplementary material](#)). All other pairwise comparisons between slopes were conducted using the postestimation "test" command in Stata 14. Age-related slopes differed significantly between children in the Hearsay and Internet conditions,  $F(1, 167) = 8.24, p = .005$ , and differed marginally between children in the Hearsay and Book conditions,  $F(1, 167) = 3.57, p = .061$ . Age-related slopes were similar for children in the Book and Internet conditions,  $F(1, 167) = 1.04, p = .308$ .

To further examine age-related patterns using these fitted regression lines, subsequent analyses examined whether levels of belief differ between conditions for children at 5.0 and 8.0 years of age (using Stata's postestimation "test" command). At 5.0 years, children in the Hearsay condition reported significantly greater belief than children in the Internet condition,  $F(1, 167) = 8.08, p = .005$ , and marginally greater belief than children in the Baseline condition,  $F(1, 167) = 2.93, p = .089$ . Children in the Book condition also reported significantly greater belief than children in the Internet condition,  $F(1, 167) = 4.13, p = .043$ . In contrast, at 8.0 years, children in the Hearsay condition expressed significantly less belief than children in the Baseline condition,  $F(1, 167) = 5.78, p = .017$ , and children in the Book condition,  $F(1, 167) = 4.74, p = .031$ , and they expressed marginally less belief than children in the Internet condition,  $F(1, 167) = 2.78, p = .097$ . All other comparisons were nonsignificant ( $ps > .10$ ).

Thus, 5-year-olds' belief that improbable events could occur was greatest when they had heard about events via hearsay and was lowest when they heard about events via the internet. With age, belief generally increased among children in the Baseline condition, children who heard claims



**Fig. 1.** Fitted regression lines for age-related trends in belief in improbable events among children who heard no claims (Baseline condition) and children who heard about events when the purported source was spoken hearsay, a book, or the internet (Hearsay, Book, or Internet condition, respectively).

**Table 1**

Linear regression predicting belief in improbable events.

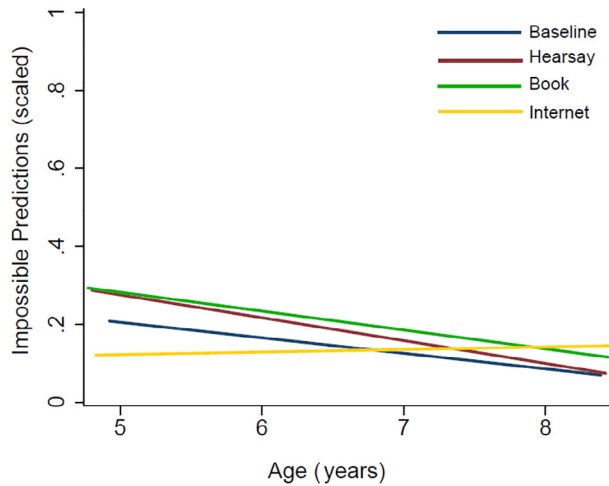
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% confidence interval
Hearsay	.73	.30	2.45	.015	[.14, 1.31]
Book	.21	.29	0.74	.461	[−.36, .78]
Internet	−.20	.29	−0.68	.495	[−.78, .38]
Age	.05	.03	1.63	.105	[−.01, .10]
Hearsay × Age	−.12	.04	−2.61	.010	[−.20, −.03]
Book × Age	−.03	.04	−0.66	.513	[−.11, .06]
Internet × Age	.02	.04	0.42	.678	[−.07, .10]
Constant	.12	.20	0.63	.527	[−.26, .51]
Model fit:	$F(7, 167) = 2.31, p = .029, R^2 = .09$				

*Note.* The Baseline condition served as the reference group. Age = slope for age in the Baseline condition. Interactions of Condition (Hearsay, Book, and Internet) × Age are tests of whether an age slope differs between that condition and the Baseline condition.

obtained from books, and (especially) children who heard claims obtained from the internet [collective correlation between age and belief:  $r(138) = .21, p = .013$ ]. In contrast, with age, belief *decreased* among children who heard about events via hearsay [correlation between age and belief:  $r(37) = −.29, p = .083$ ]. Thus, by 8 years of age, children were most skeptical about events sourced from hearsay relative to children in the other conditions.

### Impossible events

A similar regression analysis was performed predicting children's beliefs in the likelihood of impossible events based on children's age and condition (see Table S2 for descriptive data). This analysis included age as a continuous variable, source as three dummy-coded variables (hearsay, book, and internet), and interactions of Age × Source; the Baseline condition served as the comparison condition. Fig. 2 depicts the fitted regression lines for age-related trends among children in each condition. This analysis (see Table 2) revealed only a marginal negative effect of age among children in the Baseline condition. The lack of interaction effects between condition and age indicates that the age-related slope for children in the Baseline condition was similar to the slopes for children in the Hearsay, Book, and Internet conditions. (An ordinal logistic regression also yielded no main effects or interaction



**Fig. 2.** Fitted regression lines for age-related trends in belief in impossible events among children who heard no claims (Baseline condition) and children who heard about events when the purported source was spoken hearsay, a book, or the internet (Hearsay, Book, or Internet condition, respectively).

**Table 2**  
Linear regression predicting belief in impossible events.

	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% confidence interval
Hearsay	.16	.23	0.70	.484	[−.29, .63]
Book	.12	.23	0.53	.599	[−.33, .57]
Internet	−.31	.23	−1.37	.174	[−.77, .14]
Age	−.04	.02	−1.75	.082	[−.08, .01]
Hearsay × Age	−.02	.03	−0.54	.590	[−.09, .05]
Book × Age	−.01	.03	−0.25	.799	[−.08, .06]
Internet × Age	.05	.03	1.36	.176	[−.02, .11]
Constant	.40	.15	2.62	.010	[.10, .71]
Model fit:	$F(7, 167) = 2.31, p = .029, R^2 = .09$				

*Note.* The Baseline condition served as the reference group. Age = slope for age in the Baseline condition. Interactions of Condition (Hearsay, Book, and Internet) × Age are tests of whether an age slope differs between that condition and the Baseline condition.

effects involving condition; see Table S4 in [supplementary material](#)). Thus, across conditions, belief about impossible events generally decreased with age [collective correlation between age and belief:  $r(175) = -.21, p = .005$ ].

Additional analyses examined whether levels of belief differ between conditions for children at 5.0 and 8.0 years of age (using Stata's postestimation "test" command). At 5.0 years, children in the Hearsay condition reported significantly greater belief than children in the Internet condition,  $F(1, 167) = 4.46, p = .036$ , and children in the Book condition reported significantly greater belief than children in the Internet condition,  $F(1, 167) = 5.09, p = .025$ . No other pairwise comparisons were significant. At 8.0 years, children's belief in the impossible events was similar regardless of condition [all  $F_s(1, 167) < .90, p_s > .34$ ].

## Discussion

Much of the information that children and adults acquire through testimony is secondhand—derived from others' spoken messages, books, and (increasingly) the internet. Our findings suggest that secondhand claims have a stronger influence on 4- to 8-year-olds' beliefs about improbable events than



their beliefs about impossible events, supporting the idea that children's response to testimony is heavily contingent on the extent to which that new information conflicts with their existing knowledge (for a review, see Lane, 2018). Intriguingly, children's belief in purported events varied based on the specific secondhand source—spoken hearsay, a book, or the internet.

Consistent with previous findings (Lane et al., 2018), young children (4 and 5 years) demonstrated greater belief in improbable events sourced from spoken hearsay relative to children who heard no claims about the events (i.e., Baseline condition). In addition, older children (8 years) were particularly skeptical of information sourced from spoken hearsay, demonstrating less belief in improbable events relative to children who heard no claims. Younger children may interpret hearsay as implicitly signaling consensus—at least consensus between the current speaker and their source—and consensus among informants can boost children's belief in purported information (Corriveau et al., 2009). Perhaps older children consider a speaker's reference to hearsay as a means to distance themselves from the source, thereby signaling uncertainty. Through personal experience, older children may have also learned that gossip—often transmitted through spoken word—is unreliable.

Importantly, the current study identifies boundary conditions for the effects of secondhand claims on children's belief; children's judgments of whether an event could occur differed depending on the source of the secondhand information. For children across the entire age range, the extent to which they believed that events could occur was *equivalent* whether they heard claims that referenced books or heard no claims about the events (i.e., Baseline condition). In contrast to prior work where children observed an informant reading printed text and then children preferentially endorsed claims based on the printed text (typically printed labels with object names; e.g., Corriveau et al., 2014; Einav et al., 2018), our data suggest that children are not compelled to believe text-based claims in the absence of the actual text, especially when children are not forced to endorse a claim from text versus another source (in the current study, children could simply decide to not believe a claim). Although older children were more likely to believe in improbable events after hearing claims referencing a book versus claims referencing hearsay, their beliefs in claims sourced from books were no greater than baseline. Older children may view publication in a book as a sign of consensus or authority, but they may require additional information about the book itself before allowing claims referencing those books to influence their beliefs. Further work exploring children's judgments of testimony referencing books from different genres (e.g., history, fairy tales) could help to clarify this possibility. On any account, the current findings provide evidence against the general assertion that children treat text as an especially authoritative source (Corriveau et al., 2014). To the contrary, text does not seem to be particularly authoritative when children learn about events that are inconsistent with their intuitions (i.e., improbable or impossible events) and when they are not *forced to endorse* an information source. Moreover, the current findings highlight how the influence of text on children's beliefs varies depending on the specific source of the text.

Paralleling findings using selective trust paradigms (Danovitch et al., 2016; Wang et al., 2019), younger children were particularly wary of claims referencing the internet, believing in improbable and impossible events less often than when claims referenced hearsay or books. Young children rarely believe that impossible events can happen in real life (e.g., Shtulman & Carey, 2007), and testimony referencing the internet may intensify young children's doubt that impossible events can occur. By 8 years of age, children believed in purported events at similar rates whether claims referenced the internet or a book or whether children heard no claims at all. This age-related trend may reflect increasing familiarity with the internet; children may take a skeptical stance toward information from unfamiliar sources and become more trusting as they gain experience in using the internet to obtain information. Alternatively, older children may have assumed that the information presented in the Baseline condition was derived from a source such as the internet or a book.

The current findings leave open questions of whether the trajectory of increasing belief in claims referencing the internet continues into later development or whether additional shifts occur (e.g., adults may be especially *skeptical* of internet-based claims). Although books and the internet both are secondhand sources, children do not treat them the same as spoken hearsay. One explanation for older children's stronger belief in improbable events derived from text-based sources (vs. spoken hearsay) is that information from books and the internet is published, more "permanent," and widely accessible (i.e., someone who does not know the author can still access the author's statements).



Another potential explanation is that older children assumed that book and internet sources included supporting visual evidence of the event such as photographs and videos (but Shtulman & Carey, 2007, found that photographs have limited influence on children's beliefs that extraordinary events can occur). Although there is ample evidence for general age-related trends in children's experience in reading books (e.g., Rathbun, West, & Hausken, 2004; Zickuhr, Rainie, & Purcell, 2013) and using the internet (Ofcom, 2019; Rideout, 2017), the current study did not account for children's personal experiences in using these media. Given that the implementation of guidelines such as the most recent International Society for Technology in Education (ISTE) standards varies widely (see <https://www.iste.org/standards>), the messages children receive from teachers about the reliability of book and internet sources may vary between grade level and classroom. Future studies may directly explore relations between children's experience with text-based sources, including their exposure to formal education about different types of media, and their trust in these sources. Such work would be particularly revealing and ecologically valid if (as in the current study) children are asked to judge one claim at a time rather than asked to choose among simultaneous claims from different sources.

In the information-rich modern world, secondhand claims abound. Discerning whether a purported claim is accurate, particularly when it involves unusual or extraordinary information, can be challenging even for adults (e.g., Pennycook & Rand, 2019). The rapidly increasing availability of information via the internet has led to an unprecedented need to pay attention to where claims originate and to be vigilant about trusting secondhand sources. One might think that young children would be quick to trust secondhand claims from text-based sources. However, it is clear from the current findings that, when judging the reality status of a purported event, children are sensitive not only to the nature of the event but also to *where* the speaker obtained the information.

## Acknowledgments

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## Appendix A

### List of events

#### Improbable

Put a broken egg back together  
 Drank onion juice  
 Ran for 10 hours without stopping  
 Made blue applesauce  
 Painted dots on an airplane  
 Grew a beard down to their toes  
 Walked through a fire  
 Talked without moving their lips

#### Impossible

Turned a scrambled egg back into a whole egg  
 Turned an onion into a banana  
 Ran for 10 days without stopping  
 Turned applesauce back into an apple  
 Painted dots on a cloud  
 Grew from an adult back into a baby  
 Walked through a brick wall  
 Spoke two languages at the same time

## Appendix B. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jecp.2020.104808>.

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