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Children's Beliefs about Possibility Differ Across Dreams, Stories, and Reality

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Abstract

Are children's judgments about what can happen in dreams and stories constrained by their beliefs about reality? This question was explored across three experiments, in which 469 4- to 7-year-olds judged whether improbable and impossible events could occur in a dream, a story, or reality. In Experiment 1, children judged events more possible in dreams than in reality. In Experiment 2, children also judged events more possible in dreams than in stories. Both experiments also suggested that children's beliefs about reality constrain their judgments about dreams and stories. Finally, in Experiment 3 children were asked about impossible events more typical of dreams and stories. In contrast with the other experiments, children now affirmed the events could happen in these worlds.

Keywords: possibility; extraordinary events; fantasy; dreaming; conceptual development

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It is impossible for a person to soar through the air unaided by modern technology, or to gain and use magical powers. Yet many people experience these events firsthand, as both are common in the dreams of adults around the world (e.g., Nielsen et al., 2003; Schredl, Ciric, Götz, & Wittmann, 2004; Yu, 2008). People regularly encounter these events in worlds of fiction as well. Some of the highest grossing books and films of all time (e.g., Harry Potter, The Avengers) feature characters that fly and use magic, and do so amidst a flurry of other equally reality-defying events. Adults easily affirm that such events are possible in dreams and fiction, but impossible in real life.

These observations suggest that adults' judgments about whether an event can happen depend on both its nature (e.g., whether the event is ordinary or fantastic) and the world (i.e., reality, dream, or story) in which it is embedded. In this paper, we examine how these two factors affect children's judgments of what is possible. Previous studies show that children believe that some regularities and constraints of their local environments may not hold in distant places, like a far-off country or another planet (e.g., Bowman-Smith, Shtulman, & Friedman, 2019; Lockhart, Abrahams, & Osherson, 1977; Komatsu & Galotti, 1986; Miller, Custer, & Nassau, 2000; also see Dias & Harris, 1988 and Richards & Sanderson, 1999). Previous studies also show that children's own cultural backgrounds affect their judgments about what is possible, particularly when they consider whether socio-moral norms can be violated (Chernyak, Kang, & Kushnir, 2019; Chernyak, Kushnir, Sullivan, & Wang, 2013). Asking children about which events can happen in other worlds (e.g., dreams, stories) is another way of manipulating the context of their judgments about possibility. We use this manipulation to better understand the

extent to which children's judgments are constrained by their beliefs about what is possible in reality.

At present, we know that young children's judgments about what can happen in the real world vary across different types of events. Like adults, children as young as age 4 affirm that ordinary events can happen in the real world, and deny that physically impossible can happen. However, young children also deny that many improbable events can happen (Shtulman & Carey, 2007). For 4-year-olds having a pet lion is almost as impossible as walking through a brick wall, while for adults it is almost as possible as wearing a baseball cap. As children grow older, they increasingly recognize that events like owning a pet lion are possible. But it is not until adulthood that people largely accept that improbable events can happen (Shtulman & Carey, 2007). This pattern of findings has proven robust (Cook & Sobel, 2011; Lane, Ronfard, & El-Sherif, 2018; Lane, Ronfard, Francioli, & Harris, 2016; Nancekivell & Friedman, 2017; Nolan-Reyes, Callanan, & Haigh, 2016; Shtulman, 2009; Shtulman & Phillips, 2018; Weisberg & Sobel, 2012).

We know less about how children judge what is possible in dreams and fictional worlds. Although many patterns of judgment could be anticipated, we contrast two alternatives. At one extreme, we might expect children's judgments about dreams and stories to substantially differ from their judgments about reality. Whereas children are conservative in accepting that improbable events can occur in reality, and more conservative still for impossible events (e.g., Shtulman & Carey, 2007), they might readily accept that both kinds of events can happen in dreams and stories. We might expect this because children draw a firm distinction between reality and fantasy (Samuels & Taylor, 1994; Woolley & Ghossainy, 2013). For example, from age 5 children judge characters who perform impossible feats to be fictional, rather than from

history (Corriveau, Kim, Schwalen, & Harris, 2009), and from age 6, children judge that fantastical characters are more likely to perform acts that violate real-world causal principles (e.g., walking through a wall instead of using a door) than real people (Boerger, 2011).

More specific support for this expectation comes from two studies which found that children appreciate that at least some impossible events can be dreamt or imagined (Wellman & Estes, 1986; Woolley & Wellman, 1992). In these studies, 3- to 5-year-olds asserted they could both think and dream about impossible events, such as a pencil crying and an apple dancing. However, all but one of the events featured anthropomorphism. Children may find it easier to entertain the possibility of anthropomorphism than other impossible events (Van de Vondervoort & Friedman, 2017; also see Lane, Wellman, & Evans, 2010), perhaps because it is extremely common in children's fiction. So, children might be less likely to conclude that dreams (and stories) can include non-anthropomorphic impossible events (or even improbable ones).

Let us now look at the opposite extreme view. On this view, we might expect children's judgments about dreams and stories to resemble their judgments about reality. For example, as with judgments of reality, children might deny that improbable events can happen in dreams and stories, and might be even more likely to deny this for impossible events. This view might seem especially unlikely because of the findings visited above, and because children's exposure to dreams and fantastical fiction might be expected to make it obvious that fiction can include the improbable and impossible. Yet the expectation that children's judgments about dreams and stories will resemble their judgments about reality is broadly consistent with many findings suggesting that children are biased towards realism when thinking about fantastical worlds. Whereas adults often continue an overtly fantastical story with more fantastical events, children instead continue the story with realistic events (Kibbe, Kreisky, & Weisberg, 2018; Sobel &

Weisberg, 2014; Weisberg & Sobel, 2012; Weisberg, Sobel, Goodstein, & Bloom, 2013).

Children offer realistic explanations for fantastical events (e.g., buying a pet unicorn at a pet store), despite also believing that the events are impossible (Nancekivell & Friedman, 2017).

Even when asked to simply close their eyes and imagine an impossible event (e.g., walking through a brick wall), children often report that they are unable to do so, or that they imagined a possible event instead (e.g., walking around a brick wall; Lane et al., 2016). Together, these findings suggest that children's thinking about fantastic worlds is often remarkably similar to their thinking about the real world.

We conducted three experiments to investigate how children's judgments of what is possible are shaped by the nature of the events they consider and by the world in which the events are embedded. Experiment 1 compares children's possibility judgments about improbable and impossible events in reality and dreams; Experiment 2 compares judgments about these events in dreams and stories; and Experiment 3 compares judgments about these events and ordinary events across all three worlds.

Experiment 1

Method

Participants. We first asked 90 children about whether events could occur in dreams: 30 4-year-olds ($M = 4;5$ [years;months], range = 4;0-4;11, 16 girls), 30 5-year-olds ($M = 5;5$, range = 5;0-5;11, 14 girls), and 30 6-year-olds ($M = 6;5$, range = 6;0-6;11, 17 girls). We then asked a further 90 children whether the same events could occur in reality: 30 4-year-olds ($M = 4;8$, range = 4;3-4;11, 10 girls), 30 5-year-olds ($M = 5;5$, range = 5;0-5;11, 13 girls), and 30 6-year-olds ($M = 6;3$, range = 6;0-6;9, 15 girls). One additional child did not respond to the questions and was therefore replaced. For all experiments, we sought to test 30 children per age-in-years

per between-subject condition; this number was in keeping with our lab-wide stopping rule when these data were collected. Children were recruited and individually tested at childcare centers and elementary schools.

We did not formally collect demographic information from our participants, but most children in each experiment were from middle-class families in the region of Waterloo (Ontario, Canada). Approximately 85% of residents in this region are Caucasian, and the largest visible minority groups are of Chinese and South Asian descent. All studies received approval from the Office of Research Ethics at the University of Waterloo.

Materials and procedure. In all experiments, children heard descriptions of events that were each accompanied by a related photo shown on a laptop computer; see Figure 1 for all events and photos. For the dream condition, children were first asked if they were familiar with dreams (“Do you ever have dreams? And do you ever remember your dreams?”). Children then heard about twelve events and judged if the events could happen in a dream (“I’m going to tell you a bunch of things, and I want to know if they could happen in a dream. OK?”). We asked about three types of events (with four events per type): improbable events (e.g., “In a dream, could a person have a pet peacock?”), physically impossible events, hereafter called “impossible” events (e.g., “...walk through a brick wall?”), and logically impossible events, hereafter called “illogical” events (e.g., “...draw a circle that’s also a square?”).¹ Events were presented in one of two pseudorandom orders.

The procedure for the reality context was identical, except the inquiry about dreams was excluded, and children were instead asked whether the events could happen in “real life” (e.g.,

¹ Our main interest was in children’s judgments about improbable and impossible events. However, we included illogical events as a precaution to rule out a possible “yes” bias, in case children always affirmed that impossible events could happen in dreams. This did not occur. To streamline the paper we do not report results from the illogical events in the main text, though we do report them in the Supplemental Materials.

“I’m going to tell you a bunch of things, and I want to know if they could happen in real life... In real life, could a person have a pet peacock?”).

Experiments 1 & 2

In [a dream, a story, real life], could a person...

Have a pet peacock?

Walk through a brick wall?

Be sitting down and standing up at the same time?

Turn into a fish?

Have a cup full of milk that's also empty at the same time?

Have a beard that grows to the ground?

Draw a circle that's also a square?

Have an invisible dog?

Paint polka dots on a plane?

Eat pickle flavored ice-cream?*

Have a shirt that's both red all over and green all over?*

Grow money on a tree?*

Experiment 3

In a dream, a story, & real life, could a person...

Ride a magic bicycle?

Suddenly turn into a different person?

Find a room in their house that wasn't there before?

Meet a talking squirrel?

Jump off the ground and fly through the sky?

Find a castle made of clouds?

Figure 1. Events and pictures from all experiments (starred items were not included in Experiment 2). Events are arranged in one of two trial orders. Also in Experiment 3, children were asked about each world in one of three orders: dream, story, reality; reality, story, dream; story, reality, dream.

Results and Discussion

In all experiments, the main analyses used Generalized Estimating Equations models (binary logistic) with independent covariance matrices, and age-in-months was entered as a

means-centered covariate. In each experiment, we also conducted single-sample tests against chance. The data for all experiments is available [here](#).

We entered world (dream, reality), event-type (improbable, impossible), and age-in-months (mean-centered and entered as a covariate) as predictors of children's possibility judgments. We found a main effect of world, Wald $\chi^2(1) = 46.73$, $p < .001$, as children judged that more events could happen in a dream than in reality. We also found a main effect of event-type, Wald $\chi^2(1) = 70.79$, $p < .001$, as children judged that more improbable events could happen than impossible events. The main effect of age was not significant, Wald $\chi^2(1) = 2.35$, $p = .125$. However, these effects were qualified by a three-way interaction between world, event-type, and age, Wald $\chi^2(1) = 8.26$, $p = .004$.

We addressed this by running separate analyses for responses within each world (dreams, reality) with event-type (improbable, impossible) and age in months as predictors; see Figure 2. For dreams, we found a main effect of event-type, Wald $\chi^2(1) = 36.77$, $p < .001$, as children judged that more improbable events could happen than impossible events. The main effect of age was not significant, Wald $\chi^2(1) = 2.17$, $p = .141$, nor was the interaction between age and event-type, Wald $\chi^2(1) = .03$, $p = .856$. For reality, we again found a main effect of event-type, Wald $\chi^2(1) = 41.09$, $p < .001$, as children judged that more improbable events could happen than impossible events. We also found a main effect of age, Wald $\chi^2(1) = 11.42$, $p = .001$, as children were more likely with age to deny that all events were possible in reality. However, these effects were further qualified by an interaction between event-type and age, Wald $\chi^2(1) = 10.25$, $p = .001$. This occurred because as children grew older they were increasingly likely to deny that impossible events could happen in reality, Wald $\chi^2(1) = 25.43$, $p = .001$, whereas their judgments about improbable events in reality did not change with age, Wald $\chi^2(1) = 0.84$, $p = .360$.

Figure 2. Scatterplots showing the proportion of improbable and impossible events judged possible in each world (dream, reality) as a function of children's age (in months) in Experiment 1. Trendlines and 95% confidence bands are for scores within each event-type. Points are jittered to decrease overplotting.

We next conducted single-sample tests against chance. When asked about dreams, children mostly judged that improbable events could happen, $p = .001$, while their judgments about impossible events did not significantly depart from chance, $p = .052$. When asked about reality, children mostly denied the possibility of both improbable events, $p < .001$, and impossible ones, $p < .001$. (Although there was an age-related decrease for judgments about impossible events in reality, we did not run separate tests at each age-in-years as Figure 2 showed that at all ages, children denied possibility for these events even more than for the improbable events).

These findings fall between the two extreme views outlined in the Introduction. Children's judgments about dreams did importantly differ from their judgments about reality, as they were more likely to say that improbable and impossible could happen in dreams. At the

same time, there were notable similarities across these worlds. For both dreams and reality children were more likely to affirm the possibility of improbable events than impossible ones. We wanted to know whether these findings reflect beliefs specific to dreams, or instead reflect more general beliefs about possibility in fantastical or unreal worlds. In Experiment 2, we explore this by comparing children's judgments about possibility in the fantastical worlds of dreams and stories.

Experiment 2

Method

Participants. We tested 229 children. For the dream condition, we tested 30 4-year-olds ($M = 4;7$, range = 4;1-4;11, 12 girls), 30 5-year-olds ($M = 5;7$, range = 5;1-5;11, 14 girl), 30 6-year-olds ($M = 6;6$, range = 6;1-6;11, 11 girls), and 26 7-year-olds ($M = 7;3$, range = 7;0-7;11, 13 girls). For the story condition, we tested 30 4-year-olds ($M = 4;8$, range = 4;1-4;11, 17 girls), 30 5-year-olds ($M = 4;7$, range = 5;0-5;11, 18 girls), 30 6-year-olds ($M = 6;6$, range = 6;0-6;11, 13 girls), and 23 7-year-olds ($M = 7;3$, range = 7;0-7;11, 12 girls). Children were randomly assigned to either the dream or story condition. As noted above, we aimed to test 30 children per cell. However, we were unable to do so for 7-year-olds before ending data collection for the season.

Materials and procedure. The procedure was similar to Experiment 1. Children judged whether three kinds of events (improbable, impossible, illogical) could happen in one of two worlds: in a dream, or in a story. Children were first asked if they were familiar with the given world ("Do you know about dreams, like dreams you have when you're asleep?"; "Do you know about stories, like stories in books?"). They then heard about nine events, each accompanied by a

related photo, and judged whether the event could happen in the given world. Events were presented in one of two pseudorandom orders.

Results and Discussion

We entered world (dream, story), event-type (improbable, impossible), and age-in-months as predictors of children's possibility judgments; see Figure 3. We found a main effect of world, Wald $\chi^2(1) = 13.68, p < .001$, as children judged that more events could happen in a dream than a story. We also found a main effect of event-type, Wald $\chi^2(1) = 80.63, p < .001$, as children judged that more improbable events could happen than impossible events, $p < .001$. However, these effects were qualified by an interaction between world and event-type, Wald $\chi^2(1) = 6.08, p = .014$. This occurred because although the effect of event-type was significant when examining each world separately, both $ps < .001$, the difference between improbable and impossible events was greater for stories (mean difference = .25) than for dreams (mean difference = .15). We also found a main effect of age, Wald $\chi^2(1) = 12.83, p < .001$, as children were more likely with age to judge that all events could happen. No interactions with age reached significance, $ps \geq .214$.

Figure 3. Scatterplots showing the proportion of improbable and impossible events judged possible in each world (dream, story) as a function of children's age (in months) in Experiment 2. Trendlines and 95% confidence bands are for scores within each event-type. Points are jittered to decrease overplotting.

We next conducted single-sample tests against chance. Because there was an overall age-related increase in children's judgments that events could happen (unqualified by any interactions), we ran separate tests for each age-in-years. When asked about dreams, 6- and 7-year-olds both judged that improbable events could happen, $ps = .001$, 7-year-olds judged that impossible events could happen, $p = .008$, and 5-year-olds denied that impossible events could happen, $p = .037$. When asked about stories, 7-year-olds affirmed that improbable events could happen, $p = .023$, and 4-, 5-, and 6-year-olds all denied that impossible events could happen, $ps \leq .001$. No other judgments significantly differed from chance.

These findings are reminiscent of those from our first experiment comparing dreams and reality. In parallel with those findings: (1) children were overall more likely to accept that improbable and impossible events could happen in dreams than in stories; and (2) children were

more likely to accept the possibility of improbable events than impossible ones in both worlds (though this distinction was greater for stories than dreams). The fact that children were sensitive to the improbable-impossible distinction at all, though, shows that their judgments about unreal worlds are influenced by their beliefs about reality. This conclusion is also supported by the finding that children did not generally endorse the possibility of impossible events in dreams or stories (i.e., 7-year-olds' judgments about dreams were the only exception).

Overall, the findings so far suggest that children are most permissive for dreams, and least permissive for reality, with judgments about stories falling in between. This conclusion, though, relies on combining findings from separate experiments (i.e., Experiment 1 compared judgments about reality and dreams, while Experiment 2 compared dreams and stories). We therefore conducted a final experiment to see if this pattern in children's possibility judgments would replicate in a single study using a within-subjects design. We also wanted to know whether this pattern would generalize to other items. Our first two experiments used items based on those from previous investigations of children's possibility judgments (e.g., Lane et al., 2016; Shtulman & Carey, 2007). In our final experiment, we generated new items inspired by common events in dreams (e.g., Honig & Nealis, 2012; Schredl, Ciric, Götz, & Wittmann, 2004) and fantasy stories (Thompson, 1958). We tested only 5- and 6-year-olds because the previous experiments did not reveal important interactions between world and age (i.e., there were no interactions that substantially changed the interpretation of the main effects).

Experiment 3

Method

Participants. We tested 30 5-year-olds ($M = 5;5$, range = 5;0-5-11, 14 girls) and 30 6-year-olds ($M = 6;5$, range = 6;0-6-10, 18 girls).

Materials and procedure. Children were first asked if they were familiar with dreams and stories (“Do you know about dreams, like dreams you have when you’re asleep? And do you know about stories, like stories in books?”). Children then heard about six physically impossible events typical of those encountered in dreams and stories (e.g., meeting a talking squirrel, flying through the sky). Children were asked three separate questions about each event, concerning whether it could happen in a dream, in a story, or in reality (i.e., 18 judgments in total). Children were randomly assigned to hear about events in one of two orders, and answered questions in one of three orders.

We verified that these events are more dream- and story-like than those used in our previous experiments by obtaining judgments from 115 adults via Amazon’s Mechanical Turk, $p < .001$ (see Supplemental Materials).

Results and Discussion

We entered world (dream, story, reality) and age-in-months as predictors of children’s possibility judgments; see Figure 4. We found a main effect of world, Wald $\chi^2(2) = 95.55$, $p < .001$, as children thought more impossible events could happen in dreams than in stories or reality, $ps \leq .035$, and that more impossible events could happen in a story than in reality, $p < .001$. The effect of age did not reach significance, Wald $\chi^2(1) = 3.56$, $p = .059$, and the interaction between world and age was not significant, Wald $\chi^2(2) = .19$, $p = .907$. Single-sample tests showed that children mostly agreed the impossible events could happen in dreams and stories, both $ps \leq .002$, but not in reality, $ps \leq .001$.

Figure 4. Scatterplots showing the proportion of impossible events judged possible in each world (dream, story, reality) as a function of children's age (in months) in Experiment 3. Trendlines and 95% confidence bands are for scores within each world. Points are jittered to decrease overplotting.

The findings show that children judge that even impossible events can occur in dreams and stories when the events are typical of those worlds. We also extend our previous findings by again showing that children believe more events to be possible in dreams than in stories, though more events are possible in either fantasy world than in reality.

General Discussion

We found that children's judgments about whether an event is possible depends on both the nature of the event (improbable, impossible) and the world in which it is embedded (dream, story, reality). In Experiment 1, children judged that improbable and impossible events were more possible in dreams than in reality, though they endorsed the possibility of improbable events more than impossible events in both worlds. In Experiment 2, children also judged that

these events were more possible in dreams than in stories. Finally, in Experiment 3 children often judged impossible events to be possible within dreams and stories when the events were more typical of those worlds.

Our findings extend knowledge of how children conceive of dreams and stories. Earlier work examined children's understanding that dreams and stories are distinct from reality (e.g., Woolley, 1995; Woolley & Cox, 2007; also see Woolley & Boerger, 2002), and children's preferences when constructing their own fictional narratives (Sobel & Weisberg, 2014; Weisberg & Sobel, 2012). However, to our knowledge, only two studies directly examined children's beliefs about what is possible within the worlds of dreams, and these studies focused primarily on anthropomorphic events (Wellman & Estes, 1986; Woolley & Wellman, 1992).

Overall, the findings provide mixed evidence about the extent to which children's judgments about the unreal worlds of dreams and fictions are constrained by their beliefs about reality. If children's judgments about these worlds were entirely constrained by their beliefs about reality, then their judgments would have been identical across all three worlds. For instance, children should have denied that a person could have a pet peacock in both dreams and stories, as well as in reality. Instead, children were more likely to judge that such events could occur in a fantasy world than in reality.

Further, children distinguished *between* fantastical worlds, as they judged more events to be possible in dreams than in stories. This suggests that children hold nuanced beliefs about each world (Skolnick & Bloom, 2006; Weisberg & Bloom, 2009), and that these beliefs influence their possibility judgments. For instance, children may view dreams as being more distant from reality than stories, leading them to endorse more events as possible in this more distant world (Weisberg & Goodstein, 2009). Note that we did not specify the genre of fiction—we only asked

about “stories in books”. So children might be as permissive in their judgments for some genres of fiction (e.g., fantasy, fairy tales) as they are for dreams (Kibbe, Kreisky, & Weisberg, 2017).

Still, the findings of the first two experiments suggest that children’s judgments about dreams and stories are constrained by their beliefs about reality. Though children more often judged that any event could occur within dreams and stories, they showed the same graded pattern of possibility judgments (e.g., improbable events are more likely to happen than impossible ones) that they show in judgments about reality (e.g., Shtulman & Carey, 2007). These consistent distinctions between event-types suggest that children carry some of their intuitions about the real world into fantastical worlds, and support the suggestion that children’s reasoning about fantastical worlds is constrained by their real-world knowledge (Lane et al., 2016). For instance, children may use their real-world knowledge as an anchor for whether an event can occur, and then adjust their inferences based on their beliefs about each world (Tversky & Kahneman, 1974; also see Weisberg & Goodstein, 2009). Alternatively, they might anchor onto the world under consideration first, and then adjust afterwards based on their real-world knowledge. On either account, we might posit that adults judge what is possible in wildly fantastic worlds (e.g., dreams) by primarily considering the nature of the world, and discounting their beliefs about what is possible in reality.

However, the findings tell a somewhat different story when children considered impossible events more typical of dreams and stories. In the final experiment, we found that children were more willing to endorse the possibility of impossible events in dreams and stories, while also replicating children’s differentiation between the worlds. For instance, children in the first experiment were hesitant to endorse that a person could walk through a wall within a dream, while children in the final experiment mostly agreed that a person could fly through the sky.

Why were children in this final experiment more permissive in their possibility judgments? One possibility is that children in this final experiment based their judgments on a simple rule to the effect that dreams (and stories to a lesser extent) are filled with counterintuitive events. Following such a rule would allow children to bypass their beliefs about reality. However, it is difficult for us to see why children would not have adopted this same rule in the earlier experiments, where they were overall less likely to endorse impossible events happening in dreams and stories.

A more interesting possibility is that children determined whether an event could occur by recalling whether they had previously encountered it—or a similar event—in *that* particular world. On this view, children infer possibility by using an availability heuristic specific to the world under consideration (Tversky & Kahneman, 1973). Beards that grow to the ground and invisible dogs may be rare in dreams and stories, but castles made of clouds and talking squirrels are more typical of the events commonly encountered in these worlds (see Supplementary Materials). As such, children may have been more familiar with the kinds of events used in the final experiment than those from the first experiments, leading them to more often endorse the events as possible. Familiarity may also explain why children in earlier studies (Wellman & Estes, 1986; Woolley & Wellman, 1992) endorsed the possibility of anthropomorphisms in dreams at high rates (i.e., anthropomorphic content is familiar in fantasy representations).

The proposal that the familiarity of events affects children's judgments about whether they are possible is not novel. For example, in their seminal paper, Shtulman and Carey (2007) discussed whether unfamiliarity could explain why children deny that improbable events can happen in real life, and this idea has also been discussed in subsequent work on this topic (e.g., Bowman-Smith et al., 2019; Cook & Sobel, 2011; Woolley & Ghossainy, 2013). Nonetheless,

the present findings make two related contributions to this account. The findings provide preliminary evidence favoring the account, and they also suggest that children's familiarity-based judgments are specific to the world under consideration. Although much more work needs to be done, the main evidence comes from the increase in children's endorsements that impossible events could happen in dreams and stories when we used items more typical of these worlds. These findings have important implications for how children infer possibility in the real world. Children's denial that improbable events can happen in the real world is widely believed to stem from limits in their causal understanding (Schult & Wellman, 1997; Sobel, 2004; Cook & Sobel, 2011; Shutlman & Carey, 2007; Shutlman, 2009). For example, children may deny that a person can have a pet peacock because they cannot conceive of how one would be acquired or cared for. The present findings provide reason to suspect that denials of improbable events in the real world could instead stem from mere unfamiliarity. For example, children may agree that a person can wear a baseball cap because they have seen this, but deny that a person can have a pet lion because they have not.

Limitations

One limitation of this paper is that the first two experiments manipulated world (e.g., dream vs real) between-subjects, whereas the last experiment manipulated it within subjects. As such, we cannot be sure that differences between the final study and the earlier ones stemmed from the final study using items more typical of dreams and stories. Indeed, the within-subjects design used in previous studies of children's beliefs about what they can dream and imagine may have contributed to their high rates of agreement towards impossible events (Wellman & Estes, 1986; Woolley & Wellman, 1992).

A greater limitation is that we tested only children in a Western culture, who were predominantly middle-class. We see two reasons the findings might differ if the studies were run on other samples (e.g., children from other cultures). First, cultures vary in the extent to which children are encouraged or discouraged to think about and engage with fantastic content, and include it in their play (e.g., Gaskins, 2013; Taylor & Carlson, 2000). These differences could mean that children in other cultures might be less comfortable (or perhaps even more-so) in verbally endorsing the possibility of unusual and impossible events, especially when questioned by an unfamiliar adult.

Second, cultural differences could also result from variations in beliefs about dreams and stories. One striking example of the influence of culture on conceptions of dreams is that in the 1940s and 1950s, people mostly reported dreaming in black and white, rather than in color (e.g., Schwitgebel, 2002). This presumably resulted because at the time, most movies were black and white. Likewise, although we assumed that our participants viewed dreams as having little significance for everyday life, people in some cultures believe that dreams sometimes allow them to meet, and receive information from, their ancestors and spirits (e.g., Astuti, 2007; Willerslev, 2004). Perhaps such beliefs would lead to a more restricted view of which events can happen in dreams.

References

- Astuti, R. (2007). Ancestors and the afterlife. *Quaderns de l'Institut Català d'Antropologia*, 23, 61-78.
- Boerger, E. A. (2011). 'In fairy tales fairies can disappear': Children's reasoning about the characteristics of humans and fantasy figures. *British Journal of Developmental Psychology*, 29(3), 635-655. <https://doi.org/10.1348/026151010X528298>
- Bowman-Smith, C. K., Shtulman, A., & Friedman, O. (2018). Distant lands make for distant possibilities: Children view improbable events as more possible in far-away locations. *Developmental Psychology*, 55(4), 722-728. <https://doi.org/10.1037/dev0000661>
- Chernyak, N., Kang, C., & Kushnir, T. (2019). The cultural roots of free will beliefs: How Singaporean and U.S. Children judge and explain possibilities for action in interpersonal contexts. *Developmental Psychology*, 55(4), 866-876. <https://doi.org/10.1037/dev0000670>
- Chernyak, N., Kushnir, T., Sullivan, K. M., & Wang, Q. (2013). A comparison of American and Nepalese children's concepts of freedom of choice and social constraint. *Cognitive Science*, 37, 1343-1355. <https://doi.org/10.1111/cogs.12046>
- Cook, C., & Sobel, D. M. (2011). Children's beliefs about the fantasy/reality status of hypothesized machines. *Developmental Science*, 14(1), 1-8. <https://doi.org/10.1111/j.1467-7687.2009.00949.x>
- Corriveau, K. H., Kim, A. L., Schwalen, C. E., & Harris, P. L. (2009). Abraham Lincoln and Harry Potter: Children's differentiation between historical and fantasy characters. *Cognition*, 113(2), 213-225. <https://doi.org/10.1016/j.cognition.2009.08.007>

- Dias, M. G., & Harris, P. L. (1988). The effect of make-believe play on deductive reasoning. *British Journal of Developmental Psychology*, 6(3), 207-221.
<https://doi.org/10.1111/j.2044-835X.1988.tb01095.x>
- Honig, A. S., & Nealis, A. L. (2012). What do young children dream about? *Early Child Development and Care*, 182(6), 771-795. <https://doi.org/10.1080/03004430.2011.579797>
- Gaskins, S. (2013). Pretend play as culturally constructed activity. In M. Taylor (Ed.), *Oxford handbook of the development of imagination* (pp. 224-247). New York: Oxford University Press.
- Komatsu, L. K., & Galotti, K. M. (1986). Children's reasoning about social, physical, and logical regularities: A look at two worlds. *Child Development*, 57, 413-420.
<https://doi.org/10.2307/1130597>
- Kibbe, M. M., Kreisky, M., & Weisberg, D. S. (2018). Young children distinguish between different unrealistic fictional genres. *Psychology of Aesthetics, Creativity, and the Arts*, 12(2), 228-235. <http://dx.doi.org/10.1037/aca0000115>
- Lane, J. D., Ronfard, S., & El-Sherif, D. (2018). The influence of first-hand testimony and hearsay on children's belief in the improbable. *Child Development*, 89(4), 1133-1140.
<https://doi.org/10.1111/cdev.12815>
- Lane, J. D., Ronfard, S., Francioli, S. P., & Harris, P. L. (2016). Children's imagination and belief: Prone to flights of fancy or grounded in reality? *Cognition*, 152, 127-140.
<https://doi.org/10.1016/j.cognition.2016.03.022>
- Lane, J. D., Wellman, H. M., & Evans, E. M. (2010). Children's understanding of ordinary and extraordinary minds. *Child Development*, 81(5), 1475-1489.
<https://doi.org/10.1111/j.1467-8624.2010.01486.x>

- Lockhart, K. L., Abrahams, B., & Osherson, D. N. (1977). Children's understanding of uniformity in the environment. *Child Development*, 48, 1521-1531.
<https://doi.org/10.2307/1128515>
- Miller, S. A., Custer, W. L., & Nassau, G. (2000). Children's understanding of the necessity of logically necessary truths. *Cognitive Development*, 15, 383-403.
[https://doi.org/10.1016/s0885-2014\(00\)00034-4](https://doi.org/10.1016/s0885-2014(00)00034-4)
- Nancekivell, S. E., & Friedman, O. (2017). She bought the unicorn from the pet store: Six- to seven-year-olds are strongly inclined to generate natural explanations. *Developmental Psychology*, 53(6), 1079-1087. <https://doi.org/10.1037/dev0000311>
- Nolan-Reyes, C., Callanan, M. A., & Haigh, K. A. (2016). Practicing possibilities: Parents' explanations of unusual events and children's possibility thinking. *Journal of Cognition and Development*, 17(3), 378-395. <https://doi.org/10.1080/15248372.2014.963224>
- Nielsen, T. A., Zadra, A. L., Simard, V., Saucier, S., Stenstrom, P., Smith, C., & Kuiken, D. (2003). The typical dreams of Canadian university students. *Dreaming*, 13(4), 211-235.
<https://doi.org/10.1023/B:DREM.00000003144.40929.0b>
- Richards, C. A., & Sanderson, J. A. (1999). The role of imagination in facilitating deductive reasoning in 2-, 3- and 4-year olds. *Cognition*, 72, B1– B9.
[https://doi.org/10.1016/S0010-0277\(99\)00037-2](https://doi.org/10.1016/S0010-0277(99)00037-2)
- Samuels, A., & Taylor, M. (1994). Children's ability to distinguish fantasy events from real-life events. *British Journal of Developmental Psychology*, 12(4), 417-427.
<https://doi.org/10.1111/j.2044-835X.1994.tb00644.x>

- Schredl, M., Ciric, P., Götz, S., & Wittmann, L. (2004). Typical dreams: stability and gender differences. *The Journal of Psychology*, 138(6), 485-494.
<https://doi.org/10.3200/JRLP.138.6.485-494>
- Schult, C. A., & Wellman, H. M. (1997). Explaining human movements and actions: Children's understanding of the limits of psychological explanation. *Cognition*, 62(3), 291-324.
[https://doi.org/10.1016/S0010-0277\(96\)00786-X](https://doi.org/10.1016/S0010-0277(96)00786-X)
- Shtulman, A. (2009). The development of possibility judgment within and across domains. *Cognitive Development*, 24(3), 293-309. <https://doi.org/10.1016/j.cogdev.2008.12.006>
- Shtulman, A., & Carey, S. (2007). Improbable or impossible? How children reason about the possibility of extraordinary events. *Child Development*, 78(3), 1015-1032.
<https://doi.org/10.1111/j.1467-8624.2007.01047.x>
- Shtulman, A., & Phillips, J. (2018). Differentiating “could” from “should”: Developmental changes in modal cognition. *Journal of Experimental Child Psychology*, 165, 161-182.
<https://doi.org/10.1016/j.jecp.2017.05.012>
- Schwitgebel, E. (2002). Why did we think we dreamed in black and white? *Studies in History and Philosophy of Science Part A*, 33(4), 649-660. [https://doi.org/10.1016/S0039-3681\(02\)00033-X](https://doi.org/10.1016/S0039-3681(02)00033-X)
- Skolnick, D., & Bloom, P. (2006). What does Batman think about SpongeBob? Children's understanding of the fantasy/fantasy distinction. *Cognition*, 101(1), B9-B18.
<https://doi.org/10.1016/j.cognition.2005.10.001>
- Sobel, D. M. (2004). Exploring the coherence of young children's explanatory abilities: Evidence from generating counterfactuals. *British Journal of Developmental Psychology*, 22(1), 37-58. <https://doi.org/10.1348/026151004772901104>

- Sobel, D. M. (2011). Domain-specific causal knowledge and children's reasoning about possibility. In C. Hoerl, T. McCormack, & S. R. Beck (Eds.), *Understanding counterfactuals, understanding causation: Issues in philosophy and psychology* (pp. 123–146). Oxford, UK: Oxford University Press.
- Sobel, D. M., & Weisberg, D. S. (2014). Tell me a story: How children's developing domain knowledge affects their story construction. *Journal of Cognition and Development*, 15(3), 465-478. <https://doi.org/10.1080/15248372.2012.736111>
- Taylor, M. & Carlson, S. M. (2000). The influence of religious beliefs on parental attitudes about children's fantasy behavior. In K. S. Rosengren, C. N. Johnson, & P. L. Harris (Eds.), *Imagining the impossible. Magical, scientific, and religious thinking in children* (pp. 247-268). New York: Cambridge University Press.
- Thompson, S. (1958). *Motif-index of folk-literature: A classification of narrative elements in folktales, ballads, myths, fables, mediaeval romances, exempla, fabliaux, jestbooks, and local legends*. Bloomington: Indiana University.
- Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, 5(2), 207-232. [https://doi.org/10.1016/0010-0285\(73\)90033-9](https://doi.org/10.1016/0010-0285(73)90033-9)
- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185(4157), 1124-1131. <https://doi.org/10.1126/science.185.4157.1124>
- Van de Vondervoort, J. W., & Friedman, O. (2017). Young children protest and correct pretense that contradicts their general knowledge. *Cognitive Development*, 43, 182-189. <https://doi.org/10.1016/j.cogdev.2017.05.002>

- Weisberg, D. S., & Bloom, P. (2009). Young children separate multiple pretend worlds. *Developmental Science*, 12(5), 699–705. <https://doi.org/10.1111/j.1467-7687.2009.00819.x>
- Weisberg, D. S., & Goodstein, J. (2009). What belongs in a fictional world? *Journal of Cognition and Culture*, 9(1-2), 69-78. <https://doi.org/10.1163/156853709X414647>
- Weisberg, D. S., & Sobel, D. M. (2012). Young children discriminate improbable from impossible events in fiction. *Cognitive Development*, 27(1), 90-98. <https://doi.org/10.1016/j.cogdev.2011.08.001>
- Weisberg, D. S., Sobel, D. M., Goodstein, J., & Bloom, P. (2013). Young children are reality-prone when thinking about stories. *Journal of Cognition and Culture*, 13(3-4), 383-407. <https://doi.org/10.1163/15685373-12342100>
- Wellman, H. M., & Estes, D. (1986). Early understanding of mental entities: A reexamination of childhood realism. *Child Development*, 57(4), 910-923. <https://doi.org/10.2307/1130367>
- Willerslev, R. (2004). Spirits as ‘ready to hand’: A phenomenological analysis of Yukaghir spiritual knowledge and dreaming. *Anthropological Theory*, 4(4), 395-418. <https://doi.org/10.1177/1463499604047918>
- Woolley, J. D. (1995). The fictional mind: Young children's understanding of imagination, pretense, and dreams. *Developmental Review*, 15, 172-172. <https://doi.org/10.1006/drev.1995.1008>
- Woolley, J. D., & Boerger, E. A. (2002). Development of beliefs about the origins and controllability of dreams. *Developmental Psychology*, 38(1), 24. <https://doi.org/10.1037/0012-1649.38.1.24>

Woolley, J. D., & Cox, V. (2007). Development of beliefs about storybook reality.

Developmental Science, 10(5), 681-693. <https://doi.org/10.1111/j.1467->

7687.2007.00612.x

Woolley, J. D., & E. Ghossainy, M. (2013). Revisiting the fantasy–reality distinction: Children as naïve skeptics. *Child Development*, 84(5), 1496-1510.

<https://doi.org/10.1111/cdev.12081>

Woolley, J. D., & Wellman, H. M. (1992). Children's conceptions of dreams. *Cognitive Development*, 7(3), 365-380. [https://doi.org/10.1016/0885-2014\(92\)90022-J](https://doi.org/10.1016/0885-2014(92)90022-J)

Yu, C. K.-C. (2008). Typical dreams experienced by Chinese people. *Dreaming*, 18(1), 1-10.

<https://doi.org/10.1037/1053-0797.18.1.1>