

Denying the possible: Why children judge the improbable impossible

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Abstract

Judgments of whether events are possible or impossible matter when people choose goals and decide what to believe, yet preschoolers and even school-aged children make surprising errors when judging whether events are possible. In contrast with the popular view of children entertaining the possibility of the marvelous and fantastic, children often deny that unusual events and impermissible actions can happen in real life. They even sometimes deny these events can happen in stories and dreams. In this chapter, we review experimental work on these surprising possibility denials, including studies that have attempted to bring children to recognize these events as possible. We also review work examining other aspects of how young children judge whether events are possible, including their judgments that some impossible events are more impossible than others. We review theories that may account for young children's possibility denials and outline remaining questions for future research.



1. Introduction

Judging which events are possible and which are not is critical for many types of reasoning and something people often do with little effort. They readily conclude that some events can happen whereas others cannot. For example, people recognize that finding money on the ground or visiting Australia are real possibilities. And they likewise recognize that a single object cannot be in two places at the same time and that it is impossible for a person to levitate. When an event normally deemed impossible appears to happen, people assume they are seeing a trick. At the same time, people recognize that some remarkable and unlikely events can happen—they understand it is possible for a golfer to hit a hole-in-one and many people think that humans could colonize Mars.

The distinction between which events are impossible and which are merely unlikely could seem like the stuff of barstool philosophizing. However, incorrectly judging what is possible can have severe consequences. Sometimes people fail to see possibilities, or dismiss them as impossibilities, and therefore fail to anticipate the future. People have confidently argued against the possibility of radio signals crossing oceans, flying machines leaving the ground, and the viability of nuclear energy, only to be proved wrong within their lifetimes (Burdette, 1882; Foresight Institute, 2021). On the other hand, people sometimes mistake impossibilities for possibilities, and waste time and resources working towards unattainable goals. For instance, alchemists spent centuries attempting to discover a way to transmute lead into gold, even though this is physically

impossible (Matson, 2014). Many inventors have likewise attempted to design and create a perpetual motion machine, another physical impossibility (Angrist, 1967).

Distinguishing between what is possible and impossible is also socially important. Accepting that impossible events could happen makes people susceptible to trickery. People who believe that the future can be seen in a crystal ball may pay exorbitant amounts of money for such predictions. And when people recognize that others are affirming the impossible, this can reduce trust. For instance, suppose your friend told you that signals from cell phone towers control people's thoughts. You might worry that your friend is hallucinating and subject to delusions and come to question the truth of other things they tell you. Surprising conclusions about what is possible can signal deceit, misperceptions, or errors in reasoning.

1.1 Children's reasoning about possibility

In this paper, we review how young children distinguish between possible and impossible events. It is often assumed that young children's understanding of the world centers on their apparent credulity. After all, young children often believe in fantastical and impossible beings like the Tooth Fairy, the Easter Bunny, and Santa Claus (Woolley & Cornelius, 2013) and they worry about impossible dangers like monsters in closets or alligators under beds. The popular view of the development of possibility judgments, then, holds that young children believe that almost anything is possible and only come to see that some events are impossible as they learn more about the world.

However, research on children's reasoning about possibility indicates that this popular view of children as credulously accepting the impossible is radically incorrect. As we will see, the main quirk of young children's reasoning is not that they readily see the impossible as possible, but that they deny that many possible events could happen. Children are remarkably skeptical about the possibility of unexpected events (Harris, 2021; Shtulman, 2023; Woolley & Ghossainy, 2013). Explaining these possibility denials is challenging, and no theoretical account proposed so far decisively explains them. Making sense of children's possibility denials will increase our understanding of how young children think about the world and will probably also inform our understanding of how we as adults make these judgments.

1.2 Scope and structure

Our focus in this paper is on children's explicit judgments about whether events could ever happen—for instance, their responses to questions about

whether a person could turn invisible, or grow money on a tree. We focus on work stemming from the surprising discovery that children's notions of possibility are more restrictive than those of adults. We do not review work that investigates other aspects of children's understanding of possibility. Hence, we do not review work on children's understanding of multiple possibilities—their understanding that a hidden toy could possibly be in any of several potential hiding spots (e.g., Leahy et al., 2022; Redshaw & Suddendorf, 2016). We also do not review children's ability to think about how events could have turned out different—their ability to think about possible counterfactual alternatives to reality (e.g., Beck et al., 2006; Nyhout & Ganea, 2019). Judgments about what is possible are related to judgments about the distinction between reality and fiction (e.g., Corriveau et al., 2009; Woolley & Van Reet, 2006), but we do not review work on this topic either. Many possible events have never happened and also will never happen, so they are not part of the real world. Also, judging that an event happened in fiction is different from judging it is impossible—you might just think it is more likely to have occurred in a story than in real life.

The remainder of the paper proceeds as follows: [Section 2](#) first outlines four major findings from research on children's judgments of what is possible and impossible. [Section 3](#) reviews follow-up work that has attempted to better understand these findings, focusing on work attempting to understand why children deny that many possible events could happen. [Section 4](#) reviews individual and group differences in children's possibility judgments. [Section 5](#) then discusses three theories for children's possibility denials, and closes by discussing challenges facing the theories. Finally, [Section 6](#) offers a conclusion and briefly outlines some remaining questions.



2. The main findings

2.1 Judgments about unusual and improbable events

Consider a person having a pet zebra, growing a beard down to their toes, or drinking onion juice. These events, though strange and improbable, are possible. Adults acknowledge this. They are about as likely to affirm that these events can happen as they are to affirm the possibility of ordinary events like washing a car or wearing a baseball cap. Young children, though, respond differently. In a seminal study, where children were first asked about these events, 4- to 6-year-olds mostly said the events could not happen (Shtulman & Carey, 2007). When they were 8-years-old, children

were more likely to affirm that improbable events could happen. But even they judged improbable events possible much less than adults.

These findings did not arise because the children were simply confused about the notion of possibility. Children were also asked about ordinary events like eating an apple and meeting a clown and truly impossible events like turning applesauce back into an apple and walking through a brick wall. Children across the full age range responded like adults for these items, reporting that the ordinary events could happen in real life and that the impossible ones could not (Shtulman & Carey, 2007). Children's success with these events fits with other work showing that by the time they are 4 or 5, children generally understand that ordinary events can happen in real life while fantastical events cannot (e.g., Carrick & Quas, 2006; Li et al., 2015; Samuels & Taylor, 1994; Woolley & Cox, 2007).

The finding that children deny the possibility of improbable events has now been replicated many times. It has been found by different research groups, who have asked children about different events, using different materials, and employing different experimental designs (Bowman-Smith et al., 2019; Danovitch & Lane, 2020; Goulding et al., 2022; Goulding & Friedman, 2020, 2021; Khan & Starmans, 2026; Lane et al., 2018; Nancekivell & Friedman, 2017; Nolan-Reyes et al., 2016; Pabla et al., 2025; Shtulman, 2009; Shtulman et al., 2023, 2024; Shtulman & Phillips, 2018; Shtulman & Yoo, 2015; Weisberg & Sobel, 2012). Children deny the possibility of unusual and improbable events both when they are asked about people engaging in strange behaviors and when they are asked about the possibility of unfamiliar machines, like voice changers and motion detectors (Cook & Sobel, 2011). Children likewise deny possibility irrespective of whether they are shown photographs depicting the events or related items (e.g., Shtulman & Carey, 2007), clipart pictures (e.g., Lane, Ronfard, et al., 2016), or no images at all (e.g., Goulding et al., 2024). These denials of possibility are also not limited to children in Western cultures. Children in China and Iran also deny that improbable events can happen (Davoodi et al., 2023; Nissel et al., 2023, 2024).

At the same time, children's denials appear to be limited to events that are improbable or unusual in a particular sense. Although children deny the possibility of events like having a pet peacock or eating pickle-flavored ice cream, they affirm possibility for some improbable events. For instance, if children are shown a bag containing ten blue marbles and one red marble, they generally understand that if a person pulls one marble out of the bag without looking, it could be the red marble (Shtulman & Carey, 2007; also

see [Nissel et al., 2024](#)). That is, they appear to understand that events which are improbable *only* in a statistical sense are still possible.¹ This conclusion is also corroborated by other studies on young children, and even toddlers, that have used quite different methods ([Cesana-Arlotti et al., 2025](#); [Stahl & Feigenson, 2024](#)). Children's denials for improbable events, then, may be specific to events that are also improbable or unusual in some additional sense ([Shtulman & Carey, 2007](#)). A fully worked out characterization of what kinds of events children see as impossible, though, may hinge on coming to understand *why* children judge these events are impossible.

2.2 Judgments about norm violations

Much as young children deny the possibility of improbable and unusual actions, they also often deny that people can violate social or moral norms (e.g., [Browne & Woolley, 2004](#); [Kalish, 1998](#); [Shtulman et al., 2023](#)). For example, in one experiment on 3- to 10-year-olds, many younger children denied the possibility of both unconventional actions like wearing pajamas to school and immoral actions like lying to a parent about school being closed ([Shtulman & Phillips, 2018](#)).²

Related denials of possibility are seen when children are asked questions relevant to their understanding of free will. Young children readily understand that a person who makes a choice could normally have done otherwise ([Kushnir et al., 2015](#)). For example, if children choose to draw a circle rather than a square, even 4-year-olds understand they could have drawn the square if they had wanted to. However, young children across several cultures often deny that people are able to act in ways that run against norms or conventions ([Chernyak & Kushnir, 2014](#); [Chernyak et al., 2013](#); [Zhao et al., 2021](#)). For example, one study found that both American and Nepalese children aged under 6 often deny that people can act against a variety of norms, including social norms (e.g., dressing in gender-typical clothing), moral norms (e.g., saying nice rather than mean things to friends), and even conventions about artifact use (e.g., using an umbrella rather than a bucket to avoid rain).

¹ Part of the reason why young children may succeed on such tasks is that the depiction of probability implies the possibility of the rare outcome. When children see the marbles, the entire set of possibilities is represented. The participant does not need to generate the sample space, only to reason with it.

² Children also sometimes infer impermissibility from impossibility. They sometimes judge that people who do the impossible or impermissible should be punished ([Nissel et al., 2024](#); [Shtulman & Phillips, 2018](#)).

Children's claims that it is impossible to engage in unconventional or immoral behavior are especially surprising. When young children deny the possibility of improbable events like having a pet peacock or eating pickle-flavored ice cream, part of the explanation could be that the events are novel—children have never seen these unusual things, and they probably have never thought about them. By contrast, children are likely to have first-hand experience with the specific social and moral norm violations they claim to be impossible. In fact, children themselves commonly violate some of these norms (e.g., [Evans & Lee, 2013](#); [Zhao et al., 2018](#)).

Nonetheless, adults also show traces of this tendency to view impermissible events as impossible. Although adults normally agree that immoral events are possible, they respond differently under time pressure. When they are forced to respond quickly, adults become more likely to indicate that immoral events are impossible ([Phillips & Cushman, 2017](#)) and that impossible events are immoral ([Acierno et al., 2022](#)). Notably, adults are not affected by time pressure in the same way when asked about other kinds of events. Responding quickly does not make adults more likely to see ordinary or improbable events as impossible.

2.3 Judgments about degrees of impossibility

Possibility is traditionally thought of as a binary; events either conform to the laws of physics and are possible or they violate those laws and are impossible. However, some impossible events seem more impossible than others. Consider how magical events are depicted in fiction. In Ovid's *Metamorphoses*, people are more likely to be turned into animals than plants, more likely to be turned into plants than inanimate objects, and more likely to be turned into inanimate objects than immaterial substances ([Kelly & Keil, 1985](#)). Similar patterns have been observed in Grimm's fairytales ([Kelly & Keil, 1985](#); [Norenzayan et al., 2006](#)), as well as more modern works of fiction like the *Star Wars* movies and the *Harry Potter* books ([Shtulman & Morgan, 2017](#)). A common trope in these stories is that some impossibilities are easier to bring about with magic than others; it is easier, for instance, to levitate a feather than to levitate a book and easier to heal a cut than to heal a broken bone.

Adults' intuitions accord with these tropes. Some impossible events strike adults as more impossible than others, as revealed by studies that have asked people to rate the difficulty or interestingness of magical transformations ([Griffiths, 2015](#); [Lewry et al., 2021](#)). For instance, it is impossible to make a frog double in size, and it is also impossible to make a frog vanish

into thin air, but most people rate the second transformation as more difficult than the first (McCoy, & Ullman, 2019). A spell for levitating a bowling ball is judged to be more difficult than a spell for levitating a basketball, and such intuitions remain consistent across adults of different cultures (Gong & Shtulman, 2021; Shtulman & Morgan, 2017).

Young children also see possibility as graded (Shtulman & Morgan, 2017; Tipper et al., 2024). In one study, 4- to 5-year-olds were introduced to the world of Harry Potter and the idea that magic spells can be easy or hard (Shtulman & Morgan, 2017). Children were then asked about pairs of magic spells, where adults reliably judge one spell to be easier than the other. Children's judgments corresponded with those of adults for about half the pairs. Children chose between the spells at chance rates for the other half. For example, children and adults both said that levitating a basketball would be easier than levitating a bowling ball. But whereas adults thought it would be easier to transform a human into a monkey than into a pig, children saw both transformation spells as similarly difficult.

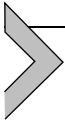
2.4 Events in fiction and dreams

Children's conceptions of possibility are also restrictive when they think about fantastical worlds. One sign of this comes from children's judgments about which events to include in stories. In one landmark study, 4-year-olds saw stories with many fantastical events, and then chose which of two events to include in the story, a further fantastical event or a realistic one (Weisberg et al., 2013). The 4-year-olds mostly chose to include the mundane event. This finding was subsequently replicated and extended with other types of stories and other types of events (e.g., Kibbe et al., 2018; Sobel & Weisberg, 2014; Thorburn et al., 2020). In one other study, 4-year-olds chose improbable events or impossible ones for a story with other improbable events (Weisberg & Sobel, 2012). This suggests that children distinguish between impossible and improbable events despite claiming both are impossible, which could constitute further evidence that they see events as more impossible than others.

Children likewise show evidence of restrictive notions when they are explicitly asked about which events can happen in stories or dreams. This is different from choosing which events to include in stories. Choosing what to include could reflect preferences for certain kinds of story events. Judgments about what can happen in a story more closely resemble those about what can happen in real life. In one study, 4- to 6-year-olds thought more kinds of events would be possible in a dream than in a story, despite

both kinds of worlds being unrestricted by causal rules (Goulding & Friedman, 2020), and they denied that many impossible events could happen in both.

At the same time, children do acknowledge that some impossible events can happen in stories and dreams (Goulding & Friedman, 2020; Ho et al., 2024). For instance, 3–5-year-olds recognize that a person in a story might be able to repair a chair by using a magic wand (Stonehouse et al., 2026; also see Ho et al., 2024). Likewise, 4- to 6-year-olds predominantly say that impossible events can happen in stories and dreams alike if the events are typical of stories and dreams (Goulding & Friedman, 2020).



3. Exploring the main findings

It is surprising that children deny the possibility of events that could happen. To better understand this, researchers have probed children's possibility denials in a variety of ways—for instance, seeing if children continue to show signs of believing events are impossible when asked different questions and seeing whether any task manipulations bring children to affirm events as possible.

3.1 Different test questions

In most studies examining children's beliefs about possibility, children were asked yes/no questions about whether events could happen in real life. Some studies have also yielded graded responses, either distinguishing possibility from levels of impossibility, for instance, “kinda impossible” versus “very impossible” (Shtulman & Phillips, 2018; Shtulman et al., 2023) or impossibility from different levels of possibility, namely, “likely” and “unlikely” (Khan & Starmans, 2026). This approach is consistent with the claims, just reviewed, that children see impossibility as graded. Both have yielded similar patterns overall, though with graded responses older children may be more likely to acknowledge that improbable events can happen (Khan & Starmans, 2026).

If children's judgments of possibility had only been probed using these questions, a potential concern might be that their surprising denials arise from misunderstandings of test questions. For instance, one might worry that rather than seeing the questions as asking about possibility versus impossibility, children instead think they are being asked about what *should* happen or what *would* happen under normal circumstances. Fortunately, though, other kinds of questions have been used.

3.1.1 Magic

Some studies have elicited judgments about whether events are possible in terms of magic (“Would it take magic for that to happen?”) rather than modality (“Could that happen in real life?”).³ Asking about whether magic is required for an event is useful for probing beliefs about possibility because magic should only be needed to produce an event if it were otherwise impossible.⁴ Studies asking about whether magic is required for events typically find that young children make similar judgments to when they are directly asked if the events could happen. They often claim that magic is required to bring about physically impossible events, like walking on water, but also that it is required to bring about merely improbable events, like finding an alligator under the bed (Nissel et al., 2024; Shtulman & Carey, 2007; Shtulman & Phillips, 2018). Children also sometimes cite magic for events that violate social norms, like lying to a parent (Browne & Woolley, 2004; Shtulman & Phillips, 2018). This said, children say events require magic somewhat less than they claim the events are impossible. Whereas younger children firmly deny that improbable events could happen in real life, they claim these events require magic at chance rates or less. Also, 4- to 8-year-olds in one recent study spontaneously offered magic as the explanation for impossible events, but they *never* did this for improbable events (Nissel et al., 2024).

3.1.2 Actuality

Children’s surprising possibility denials also turn up in their judgments of actuality—that is, in their judgments about what has actually happened. In one experiment, 4- to 7-year-olds were asked whether ordinary, improbable, and immoral events have ever happened (Pabla et al., 2025).

³ As we saw above, asking about magic was the chief way that work has examined children’s notions of graded impossibility.

⁴ At the same time, claiming that an event requires magic could be seen as suggesting that it would be possible in real life, and that magic would have to be its cause. That is, children could see magic as necessary for events that defy ordinary or natural explanation, but which are still possible (Phelps & Woolley, 1994; Rosengren et al., 1994). Consistent with this, children in some studies have been shown seemingly impossible live events—like one object transforming into another (Subbotsky, 1994) or one object passing through another (Chandler & Lalonde, 1994)—and then asked whether it was “real magic” or a “magic trick.” School-aged children tend to classify the events as tricks, but preschoolers tend to classify them as real magic (Chandler & Lalonde, 1994; Rosengren & Hickling, 1994). Such findings also suggest that younger children may think that impossible events can happen in real life under special circumstances, such as when performed by a magician (Johnson & Harris, 1994; Rosengren et al., 1994), though there are pragmatic reasons to doubt this interpretation (Phelps & Woolley, 1994; Rosengren & Hickling, 1994).

For instance, they were asked, “In real life, has someone ever eaten pickle-flavored ice cream?” and “In real life, has someone ever cheated in a game?” Children’s responses mirrored those when they were asked for modal judgments about whether the events could happen. They said “yes” for the ordinary events, responded “no” for the improbable events, and responses for the immoral events fell in between. Another experiment found the same pattern when 5- to 7-year-olds were told that someone had asserted each event (“Somebody said they ate pickle-flavored ice cream.”) and then judged whether the assertion could be true.

3.2 Explanations

Children are able to explain how events happen, and reference different causal forces and constructs for different kinds of events. For instance, depending on the context, they may refer to physical forces like gravity (Gelman & Gottfried, 1996; Sobel, 2004), biological causes like germs (Legare et al., 2009; Miller & Bartsch, 1997), or psychological constructs like mental states, norms, and social structures (Bartsch & Wellman, 1995; Rhodes, 2014). Children also refer to different causes when explaining why events could *not* happen. For example, 3- and 4-year-olds in one early study were told about protagonists who wanted to do things that were either biologically impossible (e.g., staying awake forever) or physically impossible (e.g., floating in the air; Schult & Wellman, 1997). Children mostly recognized that these desires could not be fulfilled and when they were asked to explain why, they predominantly gave biological and physical explanations.

The explanations young children offer for why events are impossible differ from those offered by adults, and this difference could track a developmental shift in how people assess whether an event could happen. When children justify their denials for both truly impossible events and merely improbable ones, younger children often give explanations that are redundant, and which merely restate that the event was impossible (e.g., Shtulman & Carey, 2007; Shtulman, 2009). They also sometimes reference hypothetical events that could happen in lieu of the event that would result from attempting to produce the target event. For instance, one explanation for why a person could not live without a heart referenced the consequence that might make this impossible, “You would die in five minutes.” Older children, by contrast, are increasingly likely to reference facts or principles that would prevent the event from happening in the first place, and this is the kind of explanation often provided by adults.

Other findings, though, suggest we should be cautious in assuming that explanations speak to the processes underlying possibility judgments. When 6- and 7-year-olds are asked how improbable and impossible events could come about, they are able to generate explanations, and moreover these predominantly reference natural causes, rather than magic (Nancekivell & Friedman, 2017; also see Woolley & Cornelius, 2017). For instance, some children said that unusual pets—a peacock or a unicorn—could have been obtained at a pet store. But providing these explanations does not bring children to affirm the events were possible. Even after describing how the impossible and improbable events could happen, children overwhelmingly deny the events could happen in real life.⁵ Also, even though children can justify their judgments of impossibility, the explanations could be post hoc. Even adults cite a variety of considerations (principles, precedents, or circumstances) when justifying judgments of possibility (Shtulman & Tong, 2013), suggesting that the process of justifying a modal judgment may not be the same as those involved in making the judgment. Similar patterns have been observed for permissibility judgments—another form of modal cognition—in that adults' moral judgments are not well predicted by their justifications (Cushman et al., 2006).

3.3 Other responses to event possibility

Studies have also used other measures to examine how children distinguish between different kinds of events. These include children's response times, their ability to visually imagine events, and their interest in learning more about events.

These measures all suggest that even though children often deny the possibility of both improbable and impossible events, they think about the events differently. With response times, children are overall slower than adults in judging whether events were possible (Goulding et al., 2024). But with both children and adults, judging possibility for improbable events takes longer than judging possibility for either ordinary events or truly impossible events.

In imagining events, children's abilities directly contradict the popular view of children's imagination as wild and unconstrained. In one study, 6- to 8-year-olds were asked to visually imagine different events and then

⁵ This said, explanations in this study might not have reflected children's beliefs about how the events could arise in real life. As an alternative, children may have generated the explanations by thinking about how the events would occur in a story.

asked about whether they had been able to do this (Lane, Ronfard, et al., 2016). Children struggled to imagine impossible events like a person turning applesauce back into an apple or a person turning an onion into a banana. But they had more success with improbable variants of these events, like a person turning applesauce blue, or a person making onion juice. As with other studies, though, children often denied that both kinds of events could happen, with stronger denials for the impossible events.

Finally, turning to curiosity, with age children show more interest in impossible events than improbable ones (Lewry et al., 2023). In a study of 4- and 5-year-olds, children were told about pairs of stimuli and asked which they wanted to learn about. Although the 4-year-olds responded at chance, 5-year-olds were more interested in learning about impossible things, like a statue of a lion that can turn into a real lion, than improbable things, like a basket made out of bread. The 5-year-olds were also more interested in the improbable things than ordinary ones. A similar developmental shift has been observed in whether children prefer books that describe intuitive (ordinary) events or books that describe counterintuitive (improbable) events, with 5-year-olds preferring the latter but 4-year-olds exhibiting no preference (Lane & Ronfard, 2023).

3.4 Task manipulations

Several studies have explored task manipulations that might bring children to affirm the possibility of improbable events. The effects of these manipulations have been mixed, with some manipulations producing greater affirmations of possibility than others. Even so, *no* manipulation so far has brought children to affirm possibility at rates as high as which they affirm the possibility of ordinary events.⁶

3.4.1 Time and place

Some studies have examined whether children's possibility judgments vary with when and where the events are purported to take place. The effects, though, have been relatively modest. One set of experiments found that

⁶ These effects could be interpreted as showing that children's regular possibility denials do not reflect possibility judgments in a strict philosophical sense where judging an event impossible implies that it could *never* happen—anywhere, ever, under any circumstances. On this view, if children genuinely see some event as impossible, task manipulations should not make them more likely to see it as possible. But there's also a psychological interpretation of such effects. Children's possibility judgments reflect psychological processes (e.g., reasoning, memory search, etc.) and task manipulations could affect how these processes operate.

5- to 7-year-olds were more likely to say that unusual and improbable events could happen in far-away places (or an unspecified place) than in children's own country (Bowman-Smith et al., 2019). More recent work has likewise contrasted 5- to 8-year-olds' judgments about events taking place in the past versus the future (Khan & Starman, 2026). In this work, children did see events as more possible in the future than in the past. This difference was most robust in older children's judgments about impossible events, like having a pet unicorn, flying in the sky, and becoming invisible. It did not, however, affect their judgments about improbable events.

3.4.2 Testimony and consensus

Some studies have examined whether children's possibility judgments vary depending on how they hear about events—whether they respond differently if an informant tells children about having experienced an event firsthand, or having heard about it happening from someone else (Williams & Danovitch, 2022; Lane et al., 2018), and whether they respond differently for events mentioned in books or on the internet (Danovitch & Lane, 2020). These varied ways of hearing about events sometimes affect children's affirmations of possibility, but the effects are modest. Regardless of the information source, younger children deny that improbable events could happen more often than they affirm such events.

3.4.3 Precedent

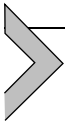
Children's beliefs about the possibility of events can be shifted by providing them with background information about similar events that have already happened, or precedents. Children are more likely to say that improbable events are possible if they are told about a relevant precedent. For example, children are more likely to say a person could have a pet zebra if they are first told about a person having a pet elephant, and they are more likely to say a person could live in a house shaped like a coffee mug if first told about a person living in a house shaped like a shoe (Goulding & Friedman, 2021).

3.4.4 Circumstances and causal information

Children's judgments are also improved by information about how certain kinds of events can be produced. In one study, children were told about how juicers work ("To use a juicer, you put stuff in it and it squeezes out all the liquid so you can pour it into a glass and drink it. So, if you put apples in it, you'll have apple juice."). By itself, this information did not affect children's judgments about the possibility of a strange and improbable

kind of juice, cauliflower juice (Goulding et al., 2022). However, children are more accepting of improbable events if the causal information is also informative about precedents (Goulding et al., 2022; Shtulman et al., 2024). For instance, children are more likely to agree that a person could drink cauliflower juice if the causal information about juicers uses the example of making pickle juice (i.e., another unusual juice) rather than apple juice. In fact, children more strongly affirm possibility when information about precedents and causal mechanisms are combined in this way, compared with when they are only given information about precedent.

Children's judgments can also be improved by information about people involved in events. Specifically, children are more likely to see improbable events as possible if the events include people that could plausibly be involved in them, and especially people who could intentionally cause them (Goulding et al., 2026). For example, children are more likely to say that drinking onion juice would be possible for a chef than for a sailor or a person in general (i.e., "someone").



4. Individual and group differences

While past research has consistently found age-related increases in children's possibility judgments about improbable events, it has also uncovered notable individual differences. Why do same-aged children sometimes diverge in their judgments of possibility? One explanation, building on the prior section, is that children draw on different knowledge bases, which in turn shapes how they reason about what is and is not possible. Children raised in religious communities, for instance, may judge events resembling miraculous or divine occurrences as possible precisely because their beliefs provide a causal framework—divine power—that makes such events conceivable. Another source of individual differences may lie in children's capacity for reflective reasoning, and this capacity may develop both through cognitive maturation and through interactions with adults.

4.1 Religiosity and culture on judgments of possibility

Religious stories often feature miraculous and incredible events and involve agents—like God—who are not subject to the same causal constraints as humans. Young children, and especially those growing up in a religious household, acknowledge that God has superhuman abilities. For

instance, they affirm that God can see inside closed containers and know the desires of far away people (Barrett et al., 2001; Lane et al., 2010, 2012; Lane, Evans, et al., 2016).

It is conceivable, then, that religious children might have a broader conception of what is possible than secular children. More specifically, religious children may be more likely to believe in the possibility of miracles. Indeed, when asked about whether miracles performed in religious stories (stories that mentioned the presence of God) were real, 6-year-old children were more likely to categorize those miraculous events as real relative to same-aged secular children (Vaden & Woolley, 2011).

Does this effect of religious belief on the possibility of causality-violating events extend beyond religious stories? The answer appears to be no. When asked about whether a possible or an impossible transformation of an object could happen, for example a tree growing flowers and a tree growing money, 5- and 6-year-old secular and religious Colombian children consistently rated the former as possible and the latter as impossible (Orozco-Giraldo & Harris, 2019). Similar results were obtained in American and Iranian children 5- to 10-year-olds (Davoodi et al., 2023; Payir et al., 2021). Religious children in these studies were more likely to state that causality-defying religious stories could happen, but secular and religious children did not differ in their assessment of causality-defying non-religious stories.

Similar conclusions can be drawn from studies investigating children's categorization of people rather than events as real (possible) rather than pretend (impossible). In one study, children were more likely than secular children to classify the main character in a religious story as real rather than pretend (Corriveau et al., 2015). Extending past research (Vaden & Woolley, 2011), they also found that religious children were more likely than secular children to judge characters embedded in fantastical stories that included ordinarily impossible events, for example, a man who parted mountains with a walking stick to escape his enemies, as real rather than pretend (for a replication with Iranian children, see Davoodi et al., 2016). However, their fantastical stories were very similar to religious ones. Moses may not have parted mountains with his walking stick but he did part the Red Sea—a relevant precedent known to many religious children, which may explain why they found the mountain-parting story plausible. Indeed, when children are asked to reason about unusual stories that are more dissimilar to religious ones than the ones used by Corriveau et al. (2015), religious and secular children do not differ in their assessment of whether a character embedded in the story is real or pretend (Davoodi et al., 2023; Payir et al., 2021).

In sum, a religious education leads children to endorse religious characters and events as real rather than pretend but does not lead children to develop a different understanding of what can and cannot happen.

4.2 Cognitive reflection

Cognitive reflection is the disposition to question an intuitive response and seek out a more accurate alternative. It is measured with brainteasers such as “What do cows drink?”. Some children answer this question with the first response that comes to mind—“milk”—whereas others reflect on this response and realize that, although cows produce milk, they actually drink water. The Cognitive Reflection Test, Developmental version (or CRT-D) consists of nine such brainteasers, and children who perform well on the CRT-D also perform well on tests of logical reasoning, statistical reasoning, and scientific reasoning (Shtulman & Young, 2023).

Suppressing an intuitive response in favor of an analytic response is a disposition that proves useful for many forms of reasoning, including reasoning about possibility. Cognitively reflective children are more likely than their peers to differentiate improbable events from impossible events, judging that a person could make garlic-flavored ice cream in real life but not lava-flavored ice cream (Shtulman et al., 2024). Cognitively reflective children are also more likely to differentiate unconventional actions from immoral actions, judging that it would be okay to wear pajamas to school in real life but it would not be okay to lie to your mother (Shtulman et al., 2023). Indeed, cognitive reflection helps children differentiate modal questions themselves, with cognitively reflective children judging that it is possible to lie to your mother but not permissible and that it is permissible to conjure a cake out of thin air but not possible (Shtulman et al., 2023). The relationship between cognitive reflection and modal cognition holds even when controlling for age, which implies that reflection improves modal judgment independent of the knowledge and experience that usually only older children possess.

4.3 Parenting

The work just reviewed suggests that some children are better able to override the intuition that improbable events are impossible by pausing to reflect. Work examining the effect of parenting on possibility judgments suggests that this capacity may be cultivated through interactions with adults.

Nolan-Reyes and colleagues (2016) tested this idea by examining whether variation in parents' use of mechanistic explanations during shared reading would predict variation in children's possibility judgments. Parents of 4- and 6-year-olds were asked to read a book with their child as they naturally would at home. The book contained descriptions of both improbable and impossible events. Children were subsequently asked to judge whether various improbable and impossible events were possible and to explain their reasoning. Even after controlling for age, children's tendency to judge improbable events as possible—and to justify those judgments with mechanistic reasoning—was predicted by the degree to which their parents had speculated on mechanisms during reading (e.g., "If they got a lion when it was a little baby and tamed it, then it could be a pet;" Nolan-Reyes et al., 2016, p. 384). Exposure to this kind of reasoning may scaffold children's ability to envision unusual hypothetical scenarios and to construct the causal chains needed to render them plausible.

Taken together, these findings suggest that sociocultural contexts, and the adult-child interactions embedded within them, play a meaningful role in shaping children's possibility judgments. By modeling causal and mechanistic thinking, adults do not merely transmit knowledge about what is possible—they may be teaching children how to reason about possibility itself.



5. Accounts of how children judge what is possible

Several accounts have been offered for how children judge whether events are possible. The main focus of these theories has been explaining children's surprising possibility denials. These accounts also differ in their claims about how reasoning about possibility changes with age and the extent to which there is continuity between children and adults.

At the same time, the accounts we review are not mutually exclusive. Multiple processes likely contribute to children's possibility judgments, pointing to the possibility of a hybrid account. The accounts we review are also unlikely to be exhaustive in that there are other ways children might judge whether events are possible. For instance, judgments that a person could never fly or have a pet unicorn could depend on children's basic factual knowledge – children may already know *people cannot fly* and *unicorns aren't real*. Factual knowledge is unlikely to explain children's denials for improbable events, though. Having a pet peacock and drinking onion juice are unlikely to be contradicted by any facts children know.

5.1 The circumstances account

On this account, children judge whether events are possible by attempting to think of circumstances by which the events could happen. If children succeed in thinking of such circumstances, by drawing on relevant causal knowledge, they conclude the event is possible. But if they are unsuccessful, they conclude it is impossible (Shtulman & Carey, 2007; Shtulman, 2009). For example, when children are asked if a person could drink onion juice, they try to imagine how a person could come to have onion juice, and if they cannot imagine any such background circumstances, they say that drinking onion juice is impossible. Consistent with this idea, children are sometimes responsive to causal information about the circumstances that could bring about improbable events (Goulding et al., 2022; Shtulman et al., 2024).

This account posits some discontinuity between children and adults. Rather than asking what circumstances could have brought an event about, adults may instead ask whether anything would prevent the event from happening, on the assumption that any event is possible unless it violates a physical principle. Adults may say that drinking onion juice is possible because they cannot think of anything that would prevent a person from making or drinking onion juice without having devised a causal pathway by which onion juice might come to exist. Some evidence for this developmental shift comes from the findings of qualitative differences between children's and adults' explanations for why events cannot happen (Shtulman, 2009; Shtulman & Carey, 2007), and especially the finding that adults—in contrast with younger children—explain impossibility by citing principles and facts that would prevent an event from happening.

5.2 The precedent account

On this account, children judge whether events are possible by asking whether these events have precedent—this is, whether they have seen or heard about similar events. If children succeed in thinking about similar prior events, they conclude the event is possible. Otherwise, they say the event is impossible and cannot happen (Goulding & Friedman, 2021). For instance, when asked if a person could have a pet zebra, children might call to mind the kinds of pets they do know of, and because this search does not include zebras or similarly exotic animals, they reject this possibility.

Consistent with this account, children are more likely to accept an improbable event if they are told of a similar event that has already

happened (Goulding & Friedman, 2021; Goulding et al., 2022). This account differs from a mere-familiarity account, in which events are judged possible if they are already known to have happened (Woolley & Cornelius, 2013). Studies have addressed whether mere familiarity could account for children and adults' beliefs about improbable events by asking whether they had already heard of the events in question. Neither children nor adults had heard of pickle-flavored ice cream or alligators under beds, yet children denied these events while adults affirmed them (Shtulman, 2009; Shtulman & Carey, 2007). The precedent account requires only that a similar event be identified, regardless of the familiarity of the target event.

The precedent account posits continuity between children and adults. Adults may also judge whether events are possible by considering their similarity to known events.⁷ If so, the differences between adults' and children's judgments about which events are possible may come down to differences in their knowledge of actual events: Adults have more experiences and memories to call on, so their store of precedents is greater. Adults may also be better at retrieving relevant memories (see Levy, & Anderson, 2002) or may need less overlap between a target event and a known precedent. Regardless, precedent is a strong predictor of possibility in adults: Their judgments about whether different events are possible are predicted by their judgments of whether the events are similar to things that have already happened (Goulding & Friedman, 2023).

Indeed, in many instances, precedent may be the only way that adults *can* judge an event's possibility. There are many events for which people have only superficial knowledge of causal mechanisms that might enable it or causal principles that might preclude it, yet they can easily form an intuition about whether the event could occur. For instance, people usually agree that a person could live to be 120 years old but do not believe a person could live to be 200 years old (Shtulman & Tong, 2013). How do they decide this? It is unlikely that most people are aware of biological factors that would preclude living to 200. But people can answer these questions by relying on known precedents: Most people probably have knowledge of individuals who have lived

⁷ A version of this account was raised in the 16th century by Michel de Montaigne. While discussing how people might reason about the possibility of strange and unfamiliar things, he asserted that "assuredly we shall find that it is rather familiarity than knowledge that takes away their strangeness" (Montaigne, 1958). The account is also similar to the availability heuristic, in which judgments are based on whether people are able to call related or similar things to mind (Tversky & Kahneman, 1973).

somewhat more than 100 years, and *no* knowledge of anyone living close to 200. So 120 years is similar to an age they *know* someone has lived to, but 200 years is too far a stretch.

5.3 The normative account

This account posits that children's possibility judgments are strongly influenced by their notions of permissibility, perhaps because representations of possibility and permissibility are not fully differentiated. In thinking about whether events are possible and can happen, children may ask themselves whether the events are permissible and should happen (Shtulman & Phillips, 2018). This would explain why children sometimes deny the possibility of violating moral and social norms and might also explain children's denials for improbable events too—having a pet peacock or drinking onion juice are irregular actions and children may therefore see them as counter normative.

The normativity account may also explain other peculiarities in children's judgments about norms, closely related to their possibility denials. Young children are often inflexible in recognizing that norms could differ across contexts, cultures, or times (e.g., Komatsu, & Galotti, 1986; Levy et al., 1995; Lockhart et al., 1977; Miller et al., 2000; Nicholls & Thorkildsen, 1988). For instance, many children claim that coins have always been round, will always be round, and that it would not be okay to change their shape (Cimpian & Steinberg, 2014).

Notions of possibility and permissibility are also intertwined in the minds of adults (Phillips & Knobe, 2018; Shtulman & Tong, 2013), so the normativity account posits continuity between children and adults. As reviewed, adults responding under time pressure often indicate that immoral actions are impossible. Underlying connections between adults' possibility and permissibility judgments are also revealed by looking at individual differences in these judgments. For instance, whereas many adults think it is morally unacceptable for a dog owner to eat her dog after it has been killed by a car, others think this is morally acceptable even if unappealing (e.g., Haidt et al., 1993). Likewise, whereas many adults think that teleporting an object to a distant location will always be impossible, others think it may be achievable in the future. And these individual differences are linked (Shtulman & Tong, 2013). Adults who see more extraordinary actions as permissible also see more extraordinary achievements as possible.

Finally, possibility and permissibility are related linguistically, as the same phrases are used in both domains. Much as we say “You can’t fly” to express impossibility, we also say “You can’t go in there” to express impermissibility. This linguistic relation is found across numerous languages and is not just a quirk of English (Phillips & Knobe, 2018).

5.4 Intuition, reflection, and uncertainty monitoring

Some findings in our review suggest that reflection affects possibility judgments and could contribute to the developmental shift towards greater acceptance of improbable events. Children higher in cognitive reflection judge more improbable events possible (Shtulman et al., 2024), and both children and adults take longer to respond to improbable events than to ordinary or truly impossible ones (Goulding et al., 2024). Yet the capacity to reflect is not sufficient on its own as one needs knowledge to reflect upon, whether that knowledge takes the form of mechanisms, principles, or precedents. And even with sufficient knowledge, deliberating over every modal judgment would be cognitively inefficient, which raises the question of when and why people reflect at all.

To fill this gap, Ronfard et al. (2025) propose that uncertainty monitoring is the missing link between intuition and reflection. When a person generates a modal intuition confidently and with ease—such as judging that someone could drink orange juice—that confidence signals that reflection is unnecessary and the intuition is endorsed as the final judgment. But when a person feels uncertain about their intuition, that uncertainty triggers deliberate reflection. Ronfard et al. (2025) argue that young children are especially prone to dismissing improbable events as impossible for two related reasons: their limited knowledge of mechanisms, principles, and precedents restricts the intuitions they can form, and their still-developing metacognitive abilities make it difficult to detect and act on their own uncertainty. As children develop through middle childhood, improvements in uncertainty monitoring may enable them to recognize when their intuitions warrant closer scrutiny—and, in doing so, to revise judgments they might otherwise have accepted without question.

One challenge for this account, however, is that knowledge and uncertainty monitoring are difficult to disentangle. A child who lacks knowledge of the relevant causal mechanisms may feel confident—not uncertain—that an improbable event is impossible, in which case better uncertainty monitoring would not help. Conversely, a child who gains the relevant causal knowledge may revise their judgment without any change

in metacognitive ability. Because knowledge and metacognitive development tend to co-occur across middle childhood, it remains unclear whether uncertainty monitoring plays an independent role or whether the developmental shift in possibility judgments is better explained by knowledge accumulation alone, or by the interaction of greater metacognitive ability and greater knowledge. Future work is needed to dissociate these accounts, for instance, by examining why children who possess the relevant knowledge often fail to revise their judgments and whether metacognitive training, in the absence of new knowledge, is sufficient to produce change.

5.5 Comparing accounts

Although each of the accounts fits with some findings, they each face challenges, and it is unclear whether any one of the accounts fully captures children's possibility judgments and their surprising possibility denials.

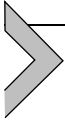
The circumstances and precedent accounts are both consistent with the ways that providing children with background information about events increases their possibility judgments. Even so, showing that children can use information provided to them does not necessarily speak to how children normally go about assessing possibility. For instance, the findings that children are more likely to see events as possible if first told about similar events does not imply that children normally assess possibility by trying to recall similar events. What's more, providing background information does not bring children to affirm possibility at ceiling rates. Both accounts may also struggle to explain why children deny the possibility of violating social and moral norms. Children have first-hand experience with many of the violations they claim to be impossible. So they should know the circumstances that would bring these events about, and they certainly know the events have precedent.

The normative account, on the other hand, struggles to explain some patterns in children's possibility denials. If impermissibility were the driving force behind their denials, children might deny possibility more strongly for impermissible events than improbable ones. But studies consistently have found the opposite. While children sometimes judge that people should be punished for doing improbable things, like drinking onion juice, they judge improbable events as punishable less often than they judge them as impossible (Shtulman & Phillips, 2018). Moreover, punishment judgments are generally not predictive of denying possibility (Nissel et al., 2024).

One way to integrate these accounts is by considering what patterns of judgment they best explain. The normative account provides a compelling explanation for why children err on the side of skepticism rather than credulity as this account assumes that children partition events into two broad categories: those they expect to happen and those they do not. The former are deemed possible and the latter impossible. There are many reasons why an unexpected event might not occur—it violates statistical regularities, it violates physical laws, it violates social conventions, it violates moral rules—yet children do not initially parse these reasons, labeling any violation as “impossible.” With age, children learn to distinguish types of violations and, accordingly, types of events that are unusual but possible.

While the normative account may explain the origin of children’s judgments, it does not explain variation in those judgments across events, individuals, or ages. The precedent account provides a better explanation for such variation. While almost all preschoolers deny that an alligator could be found under a bed, some preschoolers accept that a plane could be painted with polka dots or that ice cream could taste like pickles. Variation of this sort is perhaps best explained by knowledge of actual events: children have seen planes of varied design and eaten ice creams of varied flavor but have less knowledge of alligators and their habitats. Even though polka-dotted planes and pickle-flavored ice cream are unexpected, some children may have sufficient knowledge of these topics to sway their modal intuition from “impossible” to “possible.”

Changes in modal intuition may thus be driven, in large part, by knowledge of precedents. But the precedent account cannot explain why children are more likely to judge improbable events possible when prompted to reflect—that is, prompted to rethink their intuition through a conversation with an adult, a feeling of uncertainty, or the habit of questioning a gut response. Reflection on precedents could suffice if a relevant precedent could be found in memory, but a more reliable route would be reflecting on the circumstances surrounding the event, by identifying causal mechanisms that would bring the event about or causal principles that would preclude it from occurring. Causal knowledge is potentially more generative than isolated precedents and can be applied to a wider range of events. And although the mere presence of causal knowledge in children’s heads fails to explain why children’s default intuition is “impossible” or why that intuition changes with age, children’s *use* of causal knowledge may explain why their judgments are malleable with sufficient prompting or probing.



6. Conclusion and remaining considerations

Children's possibility denials remain surprising. Much work is still needed to understand why children deny the possibility of events for which they have sufficient knowledge to accept as possible, and how they assess whether events are possible more generally. It also remains to be seen whether other ways of probing children's possibility judgments might bring them to acknowledge that improbable and impermissible events at higher rates, approaching the ceiling rates at which they acknowledge that ordinary events can happen.

Another question is how children's possibility denials should best be characterized. On one view, these denials speak to children's *understanding* of possibility or their *beliefs* about what is possible. Indeed, it is tempting to write this way when describing and discussing children's possibility denials. This view, though, leads to the question of *how* children could come to acquire such odd beliefs about possibility. Children's possibility denials can instead be viewed as *judgments*. This framing allows that children might have relatively few existing beliefs about which events are possible and which are not. They likely do not have any beliefs about whether it is possible to own a pet peacock or to drink onion juice. Instead, children only come to judge whether these events are possible when introduced to them. And as we have seen, the judgments they reach depend on numerous factors including the way the test question is asked and whether any background information is provided. From this perspective, investigating children's judgments about possibility may be worthwhile not only for understanding how they partition the world into possible and impossible events but also for understanding how children make judgments more generally.

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