

Agents of possibility: Specifying which person an event involved helps children gauge what is possible

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Abstract

Children often deny the possibility of unusual and improbable events and immoral actions. Three preregistered experiments on 5- and 6-year-old children ($N = 154$, 47% female, 53% male, tested across three sites in Canada with varied ethnic compositions between March and September 2025) find that children better recognize that improbable events are possible when the events include agents who could plausibly be involved in them and who might want to produce them. In Experiments 1 and 2, children affirmed possibility more when unusual events were described as involving thematically related agents rather than unrelated or indefinite ones. Children also affirmed possibility more for actions that could be voluntarily chosen than for incidents that might happen involuntarily. In Experiment 3, children affirmed possibility more when improbable events involved agents with relevant motives and locations, but this did not affect children's judgments about the possibility of acting immorally. These findings suggest that children often deny the possibility of improbable events because they fail to recall relevant knowledge useful for envisaging the circumstances behind the events.

Keywords possibility, improbable events, immoral actions, motives

Lay summary

Young children often say it is impossible for people to do unusual things. For instance, they deny that a person in real life could have a pet zebra. The research reported here shows, though, that children are more likely to say unusual events can happen if they are asked about events that involve people who could plausibly be involved in the events, and who might even want the events to happen. For example, they often say a pet zebra is possible if asked about a zookeeper having one. Specifying a related person may help children imagine how unusual events could occur. Reminding children about zookeepers may help them think about where and how a person could get a pet zebra.

Young children often deny the possibility of conceptually improbable events. For instance, 4- to 8-year-old children often deny that a person could do unusual things like have a pet lion, drink onion juice, or live in a house shaped like a coffee mug (Shtulman & Carey, 2007). These possibility denials are surprising since these conceptually improbable actions are in fact possible—no physical limits, for instance, prevent a person from drinking onion juice. Moreover, these denials contradict the popular view that children are credulous and more prone than adults to believe in the far-fetched and outright impossible (for reviews, see Lane, 2018; Woolley & E Ghossainy, 2013). Nonetheless, children's possibility denials have been found in numerous studies (Bowman-Smith et al., 2019; Danovitch & Lane, 2020; Goulding & Friedman, 2020, 2021; Goulding et al., 2022, 2024; Khan & Starmans, 2026; Lane et al., 2016, 2018; Nancekivell & Friedman, 2017; Nissel et al., 2024; Nolan-Reyes et al.,

2016; Pabla et al., 2025; Shtulman, 2009; Shtulman & Phillips, 2018; Shtulman et al., 2023, 2024; Weisberg & Sobel, 2012).

One explanation for why children deny the possibility of improbable events is that when children judge whether an event is possible, they attempt to think of circumstances by which it could happen. If children succeed in envisioning relevant circumstances, they conclude the event is possible. But if children do not think of relevant circumstances, they conclude the event is impossible (Shtulman, 2009; Shtulman & Carey, 2007). On this *circumstances* account, then, children say drinking onion juice is impossible because they fail to see how a person could come to drink onion juice. Adults, by contrast, may assess possibility using a different approach. Rather than asking how an event could come about, they instead ask whether any principles would prevent it from happening.

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Some aspects of the circumstances account remain unspecified. One is representational format: Do children visually imagine circumstances leading to an event, or do they incorporate the circumstances into a story or narrative? Evidence for imagination comes from findings that children who affirm the possibility of improbable events also report more success in imagining the events than children who deny their possibility (Lane et al., 2016). The account could also be clearer about whether recognizing possibility requires children to call detailed information to mind. It is unlikely that children would have to know the exact causal steps, since even adults lack detailed causal knowledge of how many events occur (Rozenblit & Keil, 2002). The circumstances account is also not the only explanation for young children's possibility denials. For instance, another account posits that children deny possibility when events lack precedent and are dissimilar from ones children have seen or heard about (Goulding & Friedman, 2021; also see Goulding & Friedman, 2023). Children also deny the possibility of events that conflict with social and moral norms—that is, children may conflate what *can* happen with what *ought* to happen (Shtulman & Phillips, 2018; also see Phillips & Cushman, 2017 for related findings from adults).

Probing the circumstances account

The circumstances account posits that children deny the possibility of improbable events because they struggle to envision circumstances that could produce these events. But this account is compatible with several explanations for why young children struggle with this. Children's difficulty could arise from gaps in their knowledge. First, children might have gaps in their *causal* knowledge. For instance, children might deny that a person could drink onion juice because they do not know that onions yield juice, and they might likewise deny that a person could have a pet zebra because they do not know how a person could acquire one as a pet—after all, pet stores do not sell them! Children's difficulty could also result from limits in their *mentalistic knowledge*, specifically in their recognition of the range of people's desires and preferences. Even if children recognize that onions can be juiced, they might think that no one could ever want to make onion juice or drink it. Although young children, and even toddlers, recognize and even anticipate that people differ in their preferences and desires (Bélanger et al., 2014; Ruffman et al., 2018; Wellman & Bartsch, 1994), they sometimes have difficulty thinking about atypical preferences and desires even when explicitly told about them. For instance, 3-year-old children often reject that a person could like eating grass—or even like drinking coffee—after explicitly learning about a person who likes that very thing (Flavell et al., 1992).

Support for the idea that possibility denials result from gaps in children's knowledge is mixed. In some studies, children were told causal information relevant to bringing about improbable outcomes. In one set of studies, 4- to 7-year-old 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, though, this information did not affect children's judgments, and they continued to deny that improbable outcomes could happen (Goulding et al., 2022). While this finding casts doubt on the idea that possibility denials *solely* arise from gaps in knowledge, other findings support its importance. When children

are told how a similarly improbable event could arise, this information does lead them to affirm more possibilities (Goulding et al., 2022; Shtulman et al., 2024). One study found that 4- to 12-year-old children were more likely to agree that a person could have a pet zebra after first hearing about ways someone could acquire a pet crocodile (Shtulman et al., 2024). This manipulation might have operated by simultaneously increasing children's causal and mentalistic understandings—it might have increased their understanding of how pets can be acquired, while also broadening their awareness of the range of pets people might desire.

In this paper, we investigate a novel reason that children may fail to envisage circumstances that could produce improbable events. We propose a memory access explanation. Children may have difficulty thinking of the causes and preferences needed to bring improbable events about, not because they lack knowledge, but because they fail to access and recall knowledge they already have. On this view, if children were able to strategically and exhaustively search their knowledge and memories, they might imagine circumstances that would bring a person to have a pet zebra. They might, for instance, think about zoos and see circumstances that would allow a zookeeper to acquire a zebra as a pet. After all, a zookeeper might conceivably want a zebra as a pet (mentalistic knowledge) and would be well positioned to acquire one (causal knowledge). But children might struggle with this, in part because of limits in their ability to search their memories (Hjuler et al., 2023; Krøjgaard et al., 2022; Levy & Anderson, 2002).

One implication of this memory access proposal is that children might be more likely to affirm that improbable events are possible if they are reminded about knowledge they have. Children might affirm the possibility of having a pet zebra if they were specifically asked about whether this would be possible for a zookeeper. Asking about specific agents, then, might function as a cue to help children access and recall relevant knowledge. This approach is unlikely to work by filling gaps or holes in children's knowledge—after all, asking about what is possible for a zookeeper can only be effective if children already know about zoos and zookeepers.

We investigated this prediction in three experiments. In each experiment, children judged whether different kinds of agents could be involved in the occurrence of ordinary, improbable, and impossible events. For our first two experiments, we used thematically related agent-event pairs; for instance, children were asked whether a sailor could have a fish fall on their head, and whether a zookeeper could have a pet zebra. In the first experiment, we compared judgments for related pairs with scrambled pairs; for instance, children shown scrambled pairs were asked whether a gardener could have a fish fall on their head, and whether an artist could have a pet zebra. In our second experiment, we compared judgments about related agents and indefinite agents (e.g., Could a person have a pet zebra?), which is the kind of agent most commonly asked about in studies about children's possibility judgments. In both experiments, the memory access proposal predicts that children should be more likely to say events are possible when asked about thematically related pairs.

We also sought to distinguish between the effects of activating children's causal knowledge and mentalistic knowledge. In the first two experiments, we did this by asking children about two kinds of events, actions and incidents. Actions are things that an

agent chooses to do and largely depend on the agent's desires (e.g., a zookeeper having a pet zebra). They require causal knowledge and mentalistic knowledge. Incidents are things that happen to an agent and often depend on their current location (e.g., a zookeeper finding a monkey in a closet). Hence, judgments about incidents only require causal knowledge since these events can arise even if unintended and undesired. If children view actions as more possible than incidents, this would suggest that their possibility judgments not only leverage causal knowledge but also mentalistic knowledge.

In the third experiment, we used a different approach to disentangle the effects of mentalistic and causal knowledge. We compared children's judgments about several kinds of agents, including agents well positioned to bring about the outcomes (causally) and agents whose preferences made them likely to want to bring the outcomes about (mentalistic). This final experiment also had a further goal: Besides denying the possibility of improbable events, children sometimes also deny the possibility of violating social and moral rules, including violations they are likely to have seen first-hand (Chernyak et al., 2013; Kalish, 1998; Shtulman et al., 2023). For instance, many 3- to 5-year-old children in one study denied that a story character could lie to a parent or snatch another child's toy (Shtulman & Phillips, 2018). When responding under time pressure, even adults often deny that people can violate social and moral norms (Acierno et al., 2022; Phillips & Cushman, 2017). To better understand these puzzling denials, our final experiment also examined whether children are more likely to affirm that immoral actions can happen when asked about agents who might be especially able or motivated to carry them out.

In each experiment, we tested 5- and 6-year-old children. This is a comparatively narrow age range given that possibility denials have been examined in children as young as 3 years and as old as 12 years (Shtulman et al., 2024). While it would doubtlessly be more informative to include a broader age range, we felt that focusing on 5- and 6-year-old children would provide a clear preliminary test of the memory access account. Children at these ages strongly deny the possibility of improbable events and are also responsive to task manipulations (Goulding et al., 2022, 2024; Nissel et al., 2024; Shtulman & Carey, 2007). While 4-year-old children also say that improbable events are impossible, their responses are sometimes noisier, and this appears to be exacerbated in experiments with more complicated designs—for instance, experiments using within-subjects manipulations and experiments where children are provided with additional information (Goulding & Friedman, 2021). Older children, for instance, those aged 8 years, are considerably less likely than those aged 5 and 6 years to deny that improbable events can happen (Nissel et al., 2024; Shtulman & Carey, 2007).

General methods

Data, code, preregistrations, and power analyses are available at <https://osf.io/6dwm4/>. For all experiments, we report all measures, manipulations, and exclusions, and disclose deviations from the preregistrations.

We tested children at three different sites in Canada: Mississauga, Waterloo, and Winnipeg; testing occurred between March and September 2025. Children in Mississauga were tested online via Zoom, and children in Winnipeg were tested in person

at daycares, schools, and museums. Children in Waterloo were tested either online or at daycares or schools. Parents provided informed consent before participating in the study, either by filling out a web form online or a paper copy; children were also asked if they wished to participate and were not tested if they declined.

In Mississauga, among the child participants whose parents indicated their ethnicity ($n = 63$ out of 74), 27% were South Asian, 24% were Caucasian/White, 21% identified themselves with more than one ethnicity, 10% were Asian, 6% were Black/African American, 5% were Middle Eastern/Arab, and 7% of them indicated "other." In Waterloo and Winnipeg, demographic information was not collected from each child (as per the allowances of IRB applications). However, in Waterloo, 64% of residents are White; South Asians are the largest visible minority; and in Winnipeg, 53% of residents are White, and South Asians and Indigenous people are the largest visible minorities. All children saw the same Qualtrics slideshow regardless of site or delivery method.

We pre-registered testing 60 children in Experiment 1, which used a between-subjects design, and samples of 30 children in Experiment 2 and 40 children in Experiment 3, which both used within-subject designs. We recruited somewhat larger samples in Experiments 1 and 3, though, because of miscommunication about progress among testers across the different sites. Also, we pre-registered that we would analyze differences between conditions without examining effects of age. Our aim was to better understand the processes that underlie children's possibility judgments at these ages, and substantial prior work has found that children aged 5 and 6 years make these judgments comparably (Goulding & Friedman, 2021; Goulding et al., 2022; Pabla et al., 2025) and some other studies on judgments about possibility have also grouped them together (Khan & Starmans, 2026; Orozco-Giraldo & Harris, 2019; Woolley & Cornelius, 2017). The OSF page includes sensitivity power analyses conducted using PANGAEA v 0.2 (Westfall, 2016). These show that we had at least 80% power to detect medium to small effects in all analyses: An effect as small as Cohen's $d = 0.31$ in Experiment 1, $d = 0.35$ in Experiment 2, and $d = 0.30$ in Experiment 3.

In each experiment, children answered a series of yes/no questions about whether events are possible. A few children asked to switch some responses, but we kept their initial responses. Children also sometimes asked for clarification about what certain words meant (e.g., "What's a gardener?"). When this happened, the experimenter provided a brief explanation, but we excluded responses for these trials plus any others that used the same words. Responses were also missing for trials where children did not respond to a test question. Nonetheless, we had "yes" or "no" responses to over 99% of trials in each experiment.

Analyses were performed in R and were all confirmatory. We used generalized estimating equations models (GEEs) to analyze binary yes (1) or no (0) judgments; for discussion of some benefits of these models, see Frank et al., 2025. These were run with *geepack* (Højsgaard et al., 2006). They used an exchangeable correlation structure and tested for main effects and interactions. The outputs were passed through the *joint_tests* function from *emmeans* (Lenth et al., 2019) to produce Type III omnibus tests. We used *emmeans* to run post-hoc pairwise tests and to obtain means and confidence intervals for our figures; these were then plotted with *ggplot2* (Wickham, 2016).

Experiment 1

Method

Participants

We tested 76 5- and 6-year-old children ($M_{\text{age}} = 6$ years, 2 months; range = 5 years, 0 months to 6 years, 11 months; 36 girls and 40 boys). We tested 13 children in Mississauga, 54 in Waterloo, and 9 in Winnipeg. No children were excluded.

Materials and procedure

Children were first told, “I’m going to ask you about a bunch of things, and I want to know if they could happen in real life. OK?” They were then asked whether a series of improbable events could happen. The experiment used a 2×2 mixed design.

Between-subjects, children were randomly assigned to one of two conditions. In the related condition ($N=39$), agents and events were thematically linked; for instance, children were asked whether a sailor could have a fish fall on their head, and whether a zookeeper could have a pet zebra. The scrambled condition ($N=37$) featured the same events and agents but with the pairings rearranged so that they were thematically unrelated; for instance, children were asked whether a gardener could have a fish fall on their head, and whether an artist could have a pet zebra. Each agent was depicted by a cartoon drawing (all available at OSF); the events were not depicted.

Within-subjects, there were two kinds of events for each agent: actions and incidents. Actions were driven by the agent’s choices (e.g., a zookeeper having a pet zebra), whereas incidents happened outside the agent’s control (e.g., a zookeeper finding a monkey in their closet).

Children responded to twelve test trials in total (i.e., two for each agent); see Table 1 for the list of pairings. Children also responded to four filler events: two ordinary events (*Could a clown wear a hat? Could a beekeeper eat honey?*) and two impossible events (*Could a clown walk through a brick wall? Could a beekeeper find a bee bigger than a bird?*). All trials were shown in a random order. We included these to create a feeling of variety across trials and so that children could feel certain that at least some items warranted clear “yes” and “no” responses—children likely feel less certainty for improbable items (Goulding et al., 2024; also see Ronfard et al., 2025).

Table 1 Improbable events in Experiment 1.

Agent type			
related	Scrambled	Action	Incident
Artist	Zookeeper	Paint a picture on their window	Have purple paint fall onto their clothing
Farmer	Miner	Drink onion juice	Accidentally make pickle-flavored ice cream
Gardener	Sailor	Grow flowers on their roof	Find a mushroom growing under their sink
Miner	Farmer	Buy a giant rock	Trip over a giant diamond
Sailor	Gardener	Live in a house shaped like a boat	Have a fish fall onto their head
Zookeeper	artist	Have a pet zebra	Find a monkey in their closet

Note. Participants were asked about both actions and incidents. However, the questions were either about thematically related agent-event pairings or about scrambled pairings.

Results

Figure 1 shows children’s mean “yes” (1) and “no” (0) judgments. We entered these responses into a GEE with the predictors condition (related, unrelated) and event type (action, incident). Children were more likely to affirm events if the pairs were related ($M = .43$, 95% CI [.36, .50]) than scrambled ($M = .19$, 95% CI [.14, .24]), $F(1, 906) = 29.93$, $p < .001$. They were also more likely to affirm actions ($M = .33$, 95% CI [.28, .39]) than incidents ($M = .26$, 95% CI [.21, .31]), $F(1, 906) = 6.47$, $p = .011$. These factors did not interact, $F(1, 906) = .27$, $p = .607$.

Discussion

Children more often said conceptually improbable events were possible when asked about thematically related agents than unrelated agents. They were also more likely to affirm the possibility of actions than incidents—that is, they were more likely to recognize the possibility of events that are voluntarily chosen than ones that happen outside of one’s control. These findings provide preliminary support for the idea that children’s possibility denials arise, in part, because they have difficulty seeing how the events could come about.

One concern, though, is that our manipulation of thematic relatedness might have worked differently than intended. Instead of making judgments easier by introducing related agents, we might have made them harder by introducing unrelated agents. For instance, children might have denied that an artist could have a pet zebra because they could see no way that an artist might even encounter one. To follow up on this, we asked children in the next experiment about the same actions and incidents, but this time asked them about either thematically related agents or indefinite agents.

Experiment 2

Method

Participants

We tested 30 5- and 6-year-old children ($M_{\text{age}} = 5$ years, 10 months; range = 5 years, 0 months to 6 years, 10 months; 15 girls and 15 boys). We tested 19 children in Mississauga, three in

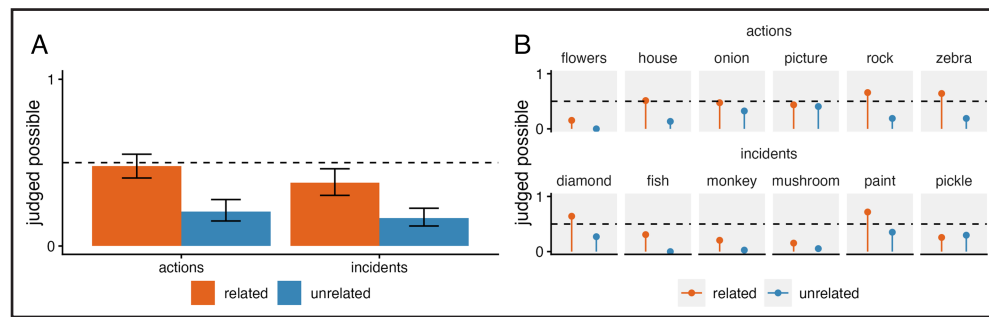


Figure 1 Mean possibility judgments in Experiment 1. Children judged whether improbable actions and incidents could happen in real life. Between-subjects, they either considered these events in relation to thematically related or unrelated agents. (Section A) shows children's mean “yes” (1) and “no” (0) judgments (with 95% CI); (Section B) shows responses for individual events.

Waterloo, and eight in Winnipeg. Six additional children were excluded: two because of experimental error and four because of interference from parents or other children.

Materials and procedure

Children again judged whether improbable events could happen in real life. This experiment used a 2×2 fully within-subjects design. One factor was agent type: Children first completed a test block where they were asked about events happening to indefinite agents. These test questions began, “In real life, could a person...” (e.g., “In real life could a person grow flowers on their roof?”). They then completed another test block where they were asked about the same events happening to specific agents that were thematically related to the events (e.g., “In real life, could a gardener grow flowers on their roof?”); these used the agent-action pairings from the related condition in Experiment 1. We always administered the block with indefinite agents before the block with specific agents because children who learn about specific agents might continue to think of these agents when asked about indefinite ones.

The other factor was event type. In each block, children were asked about 6 actions and 6 incidents. The blocks also included four filler trials: two ordinary events and two impossible ones. In the second block with specific agents, two filler trials asked about a clown and two asked about a beekeeper.

Before the first testing block, children were told, “I’m going to ask you about a bunch of things, and I want to know if they could happen in real life. OK?” Then, before the second testing block, they were told, “OK, so now I’m going to tell you about a bunch of different people, and I want to know if those people could do those things in real life. OK?” In contrast with the first experiment, children were asked the test questions without seeing pictures of the agent. We avoided pictures because we could see no clear way to visually depict indefinite people in the first block. Recent work shows that even without pictures, children show the typical pattern of denying the possibility of improbable events (Goulding et al., 2024).

Results

Figure 2 shows children's mean “yes” (1) and “no” (0) judgments. We entered these responses into a GEE with the predictors agent type (related, indefinite) and event type (action, incident). Children were overall more likely to affirm possibility for

thematically related agents ($M=0.42$ [0.32, 0.52]) than indefinite ones ($M=0.31$ [0.24, 0.38]), $F(1, 711)=9.78$, $p=.002$. They were also more likely to affirm actions ($M=0.40$ [0.31, 0.50]) than incidents ($M=0.32$ [0.24, 0.41]), $F(1, 711)=5.21$, $p=.023$. There was also an interaction between these factors, $F(1, 711)=4.96$, $p=.026$. When asked about actions, children were more likely to affirm possibility for thematically related agents ($M=0.49$ [0.38, 0.60]) than indefinite ones ($M=0.32$ [0.23, 0.43]), $t(711)=3.45$, $p<.001$. By contrast, when asked about incidents, responses did not significantly differ between thematically related agents ($M=0.35$ [0.26, 0.45]) and indefinite agents ($M=0.30$ [0.22, 0.38]), $t(711)=1.53$, $p=.126$.

Discussion

When asked about conceptually improbable *actions* (i.e., events that could be voluntarily chosen), children affirmed more possibilities for thematically related agents than indefinite agents. But with improbable *incidents*, children were similarly unlikely to affirm possibility for both kinds of agents. While these findings differ somewhat from those of the first experiment, they show that asking about thematically unrelated agents did not artificially lower children's possibility judgments. The findings also suggest that children are better able to recognize that improbable events can happen when they are prompted to consider agents who are particularly motivated or well-positioned to enable those events.

In our final experiment, we sought to better understand why specifying agents can help children recognize the possibility of conceptually improbable events. One reason is that this helps children apply their causal knowledge: The location or occupation of an agent may make it easier to see how they could be involved in the events. For instance, children might recognize that by working at a zoo, a zookeeper is likely to encounter zebras and would therefore be well positioned to acquire one. Specifying agents could also help children apply mentalistic knowledge about desires and motivations. A zookeeper might *want* a pet zebra (they chose to work with wild animals), whereas the idea of wanting a zebra might not occur to children when thinking about other kinds of agents.

To separately test these two kinds of knowledge, we asked children about five kinds of agents: We again asked about thematically related agents, thematically unrelated agents (as in Experiment 1), and indefinite agents (as in Experiment 2). But we also asked about agents at a relevant location (without a relevant motive) and about agents with relevant motives (without a relevant location). Also,

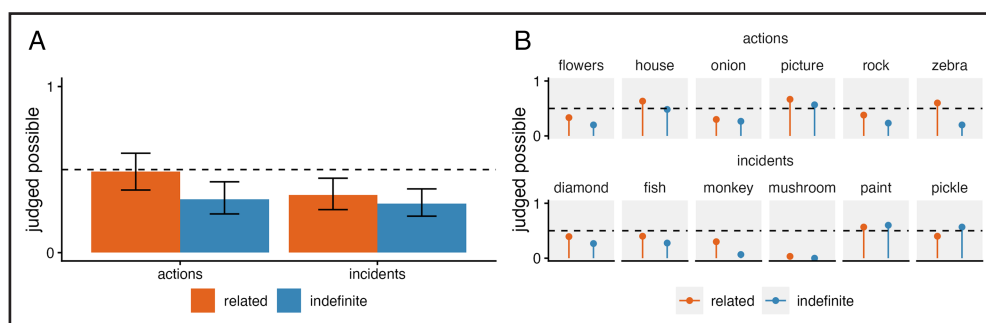


Figure 2 Mean possibility judgments in Experiment 2. Children judged whether improbable actions and incidents could happen in real life. Within-subjects, they considered these events in relation to thematically related or indefinite agents. (Section A) shows children's mean "yes" (1) and "no" (0) judgments (with 95% CI); (Section B) shows responses for individual events.

Table 2 Agents and improbable and immoral events in Experiment 3.

Type	Action	Specific agent			
		Motive + location	Motive only	Location only	Neither
Improbable	Drink onion juice	Chef	Person who likes weird foods	Person who sells juice	Sailor
	Have a pet zebra	Zookeeper	Person who likes wild animals	Person who lives in the jungle	Firefighter
Immoral	Rip someone else's drawing in half	Bully	Person who is mean	Person who sells art	Gardener
	Steal a toy	Robber	Person who likes to do bad things	Person who works at a toy store	Farmer

Note. Participants were asked whether the events were possible for all agents; in an earlier block, participants were also asked whether the events were possible for indefinite agents.

besides improbable actions, the final experiment also examined children's judgments of immoral actions. As reviewed, children often deny that these actions can happen, albeit not as often as they deny the possibility of improbable events (Shtulman & Phillips, 2018). We wondered if children might be more likely to recognize that immoral actions are possible, if asked about specific agents that might seem likely to behave immorally.

Experiment 3

Method

Participants

We tested 48 5- and 6-year-old children ($M_{age} = 5$ years, 10 months; range = 5 years, 0 months to 6 years, 11 months), 21 girls and 27 boys. We tested 42 children in Mississauga and six in Waterloo. Four additional children were excluded because of interference from parents.

Materials and procedure

This experiment used a fully within-subjects 2×5 design. One factor was action type. Children were asked about two conceptually improbable actions (drinking onion juice, having a pet zebra) and two immoral ones (stealing a toy, ripping someone's drawing in half). This block also included four filler trials where children were asked about ordinary actions and impossible ones.

The other factor was agent type. Children were asked about five kinds of agents. In a first block, they were asked about indefinite agents (e.g., "In real life, could a person..."). In a subsequent testing block, they were then asked about four other kinds of agents. For each action, there was an agent likely to have both relevant

features; an agent with a relevant motive only; an agent at a relevant location; and an agent with an irrelevant motive and an irrelevant location. For instance, children were asked if having a pet zebra would be possible for a zookeeper (motive and location), a person who likes wild animals (motive), a person who lives in a jungle (location), and a firefighter (neither); see Table 2 for a complete list of the agents.

In sum, children each answered a total of 20 test questions plus 4 filler questions.

Results

Figure 3 shows children's mean "yes" (1) and "no" (0) judgments. We entered these responses into a GEE with the predictors action type (improbable, immoral) and agent type (motive-and-location, motive, location, mismatch, indefinite).¹ There was no main effect of action type, $F(1, 1026) = 2.52, p = .113$, but there was a main effect of agent type, $F(4, 1026) = 19.83, p < .001$, and a significant interaction, $F(4, 1026) = 7.83, p < .001$. To follow up on the interaction, we separately examined the effect of agent for each action type; Table 3 summarizes the results.

With improbable actions, children affirmed possibility more often for the motive & location agent ($M = 0.68$ [0.58, 0.77]) than all other agents (indefinite, $M = 0.37$ [0.28, 0.47]; relevant location, $M = 0.55$ [0.44, 0.65]; relevant motive, $M = 0.55$ [0.44, 0.65];

¹ This is not the analysis we preregistered. We had initially planned to exclude indefinite agents from our main analysis, and to run a secondary analysis replacing responses to irrelevant agents with those for indefinite agents. Here we instead run a maximal analysis including all responses. This reduces the number of analyses and avoids a problem with the secondary analysis we had proposed (i.e., it would have inflated rates of possibility affirmations).

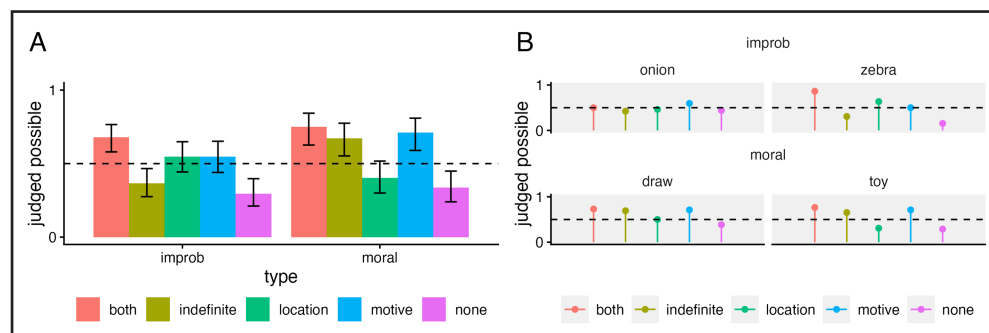


Figure 3 Mean possibility judgments in Experiment 3. Children judged whether improbable and immoral actions could happen in real life. Within-subjects, they considered these events in relation to four kinds of agents. They first judged whether these actions were possible for indefinite agents, and then judged whether they were possible for an agent likely to have a relevant motive and to be at a relevant location, an agent with the relevant motive only, an agent at a relevant location only, or a specific agent unlikely to have either relevant connection. (Section A) shows children's mean "yes" (1) and "no" (0) judgments (with 95% CI); (Section B) shows responses for individual events.

Table 3 *Post hoc* comparisons in Experiment 3.

Contrast	Improbable actions			Immoral actions		
	Odds ratio	<i>t</i> (1026)	<i>p</i> -Value	Odds ratio	<i>t</i> (1026)	<i>p</i> -Value
both/indefinite	3.69	6.12	<.001	1.46	1.90	.320
both/locate	1.75	3.04	.020	4.42	5.38	<.001
both/motive	1.75	2.57	.076	1.22	0.94	.883
both/none	5.05	6.71	<.001	5.91	5.89	<.001
indefinite/locate	0.48	−3.52	.004	3.04	4.35	<.001
indefinite/motive	0.48	−3.02	.022	0.84	−1.08	.819
indefinite/none	1.37	1.71	.427	4.06	5.27	<.001
locate/motive	1.00	0.00	>.999	0.28	−4.77	<.001
locate/none	2.89	4.44	<.001	1.34	1.10	.805
motive/none	2.89	4.17	<.001	4.86	6.40	<.001

Note. For each action type, *post hoc* comparisons of judgments between each pairing of the five kinds of agents; *p*-values for each set of comparisons are Tukey-adjusted.

irrelevant, $M = 0.30$ [0.21, 0.40]), $ps \leq .031$; *p*-values Holm-adjusted for 10 tests. They affirmed possibility more for the agent with a relevant motive than for both the irrelevant and indefinite agents, $ps \leq .012$, and likewise affirmed possibility more for the agent with the relevant location than for both the irrelevant and indefinite agents, $ps \leq .003$. All other comparisons were non-significant, $ps \geq .175$.

With immoral actions, children affirmed possibility more for three agents—the motive and location agent ($M = 0.75$ [0.63, 0.84]), the agent with the relevant motive (motive, $M = 0.071$ [0.59, 0.81]), and the indefinite agent ($M = 0.67$ [0.55, 0.78])—than for the other two agents (agent with the relevant location, $M = 0.40$ [0.30, 0.52]; irrelevant agent, $M = 0.34$ [0.24, 0.45]), $ps < .001$; *p*-values Holm-adjusted for 10 tests. All other comparisons were not significant, $ps \geq .449$.

Discussion

Children's responses differed by action type. With atypical actions, while children were most likely to affirm possibility when both motive and location were relevant, we found that each factor made distinct contributions to children's possibility judgments. As we discuss below, this suggests that both psychological knowledge of preferences and desires and causal knowledge about how

events can be produced each contribute to children's possibility judgments for improbable events.

With immoral actions, though, motive and location arguably did *not* increase judgments of possibility, since children's affirmations never exceeded those when they were asked about indefinite agents. Children were even less likely to see these events as possible for the irrelevant agent and the agent with the relevant location. This could suggest that although information about identities does not increase possibility for impermissible events, it can *decrease* it. Children may have felt the gardener and farmer would be especially unmotivated to act immorally. Likewise, in trials specifying locations only, the descriptions might have inadvertently implied motive to *not* behave immorally. Children might have assumed that a person who works in a toy store would be motivated to ensure toys are *not* stolen.

General discussion

In three experiments, 5- and 6-year-old children more often saw conceptually improbable events as possible when the events involved agents who were likely to be involved in the events and who might be motivated to produce the events. For example, children were more likely to see having a pet zebra as possible for a

zookeeper and for a person who lives in a jungle, than for an artist or an indefinite agent. Children were also more likely to see improbable events as possible if they were actions rather than incidents—that is, children affirmed possibility more for events initiated by an agent (e.g., drinking onion juice) than events that merely befell an agent (e.g., accidentally making pickle-flavored ice cream). Our final experiment also examined children's judgments about whether it is possible for agents to act immorally. Here we observed a different pattern. Children were no more likely to see acting immorally as possible for agents motivated and well located to do so than for indefinite agents. Moreover, children saw immoral actions as *less* possible for some specific agents.

These findings support four major conclusions about why children often claim that possible events are impossible. We outline these conclusions below and also discuss questions raised by our findings, limitations, and future directions.

Conclusion 1. Support for the circumstances account

Our findings suggest that children's possibility denials for improbable events arise, at least partly, from difficulties envisioning the circumstances that could bring about the events. Prompting children to think about agents that were motivated and well positioned to bring about the events likely made it easier for them to envision circumstances by which the events could occur. While it might be difficult to see how an ordinary person could come to have a pet zebra, this is likely easier to envision for a zookeeper since zookeepers at least encounter zebras with some regularity.

The effect of asking about related agents is challenging for some alternative accounts of children's possibility denials. One alternative proposes that possibility denials arise when events are dissimilar from ones that children have seen or heard about (Goulding & Friedman, 2021). Support for this account comes from findings that children are more likely to affirm that improbable events can happen if first informed about similar events. It is difficult to see, though, how the manipulations in our experiments—asking children about specific agents and contrasting actions and incidents—could have affected children's perceptions of similarity. This said, the present findings do not argue against the similarity account, since multiple factors likely contribute to children's possibility denials.

Conclusion 2. Children have difficulty accessing their knowledge

Our findings further suggest that problems with memory access contribute to children's difficulties in envisioning circumstances behind events, and hence that these difficulties do not just arise from gaps in children's knowledge. We did not tell children about the agents in our studies (e.g., we did not tell them that zookeepers often encounter zebras), and we even excluded responses from children who asked for clarification about the agents. This suggests that asking children about specific agents worked by activating their existing knowledge.²

² A caveat: In our final experiment, specifying locations (e.g., living in the jungle) and motives (e.g., liking weird foods) for some agents could have added to children's knowledge. The idea of a person liking weird foods could have been new to some children.

The memory access account suggests that some developmental differences in possibility judgments likely arise from improvements in memory search. Children struggle to search their memories for relevant events, whereas adults are much better at this (Hjuler et al., 2023; Krøgaard et al., 2022; Levy & Anderson, 2002). Hence, while adults have more relevant knowledge than children, differences in the ability to search memory for relevant knowledge may widen the apparent between what adults and children judge to be possible.

Our findings also raise the question of how children search their memories when *not* prompted to think about relevant agents. One speculative possibility is that children consult a representation of a generic or prototypical person—a representation likely to combine information about what is typical with information about what is ideal (Foster-Hanson & Rhodes, 2019; Kominsky et al., 2026). Children might then ask whether different events are possible (or perhaps likely) for this hypothetical individual. The representation children consult could also be influenced by the event children consider. Children likely have distinct generic representations for members of different social categories (e.g., girls, boys, women, men). So children might ask themselves about the generic representation most relevant to the event—they likely consider a different generic representation when judging if a person could grow a beard to their toes (Shtulman & Carey, 2007) than when judging if a person could have a pet zebra.

Conclusion 3. Causal knowledge and mentalistic knowledge both matter

So far, we have suggested that children are unable to see circumstances that could produce improbable events because they fail to access relevant knowledge. Our findings further suggest that this is both causal knowledge about physical circumstances that could help enable the events, and mentalistic knowledge about the desires and motivations that might prompt an agent to produce the events. The clearest evidence for this came from our final experiment, which showed that information about an agent's relevant location and about the agent's preferences separately increased children's affirmations for improbable events. The first two experiments also provided evidence for the importance of agent's motivations, since children more often affirmed the possibility of intentional actions than unforeseen incidents.

Asking about specific agents could also have activated children's knowledge about abilities and expertise. For instance, when asked about a person who lives in a jungle, children might feel that this person is not only well situated to acquire a zebra, but also likely to have the expertise to do so. Our participants could plausibly have considered this, since even 3-year-old children recognize differences in expertise (Lutz & Keil, 2002). Knowledge about expertise is interesting because it is both mentalistic and causally relevant; it is a kind of knowledge that positions its possessor to produce events.

Conclusion 4. Immoral actions may be different

Our results suggest that the circumstances account might not explain why children deny the possibility of immoral events. Whereas asking children about specific agents helped them

recognize the possibility of conceptually improbable actions, it did not help with immoral actions. Children were just as likely to agree that stealing a toy is possible when asked about an indefinite agent as when asked about a robber.

This conclusion may not be too surprising since we asked children about immoral actions with which they are likely to be familiar. It is difficult to believe that 5- and 6-year-old children would be unable to envision the circumstances behind stealing a toy or tearing someone else's drawing in half. Even so, it raises questions about the extent to which children's possibility denials for improbable and immoral actions are related (if at all), and about whether other manipulations might help children to acknowledge that people are capable of acting immorally.

At the same time, we cannot draw strong conclusions about differences between children's judgments about improbable and immoral actions. We examined immoral judgments in just a single experiment and asked only about two kinds of immoral actions. Findings might differ if we asked about other kinds. Also, some manipulations of agent type for the immoral events were potentially weak. Although asking about a robber or bully specifies an individual who might be motivated to act in immoral ways, it does not necessarily imply a location (or that the agent is well positioned to produce the event). This may depend on whether children imagine, for instance, the robber as already near the items to be stolen. And as we have discussed, the descriptions in trials specifying locations might have implied motives against immorality (e.g., a worker in a toy store might be assumed to dislike theft).

Limitations and future directions

One concern with the present experiments is that some aspects of the design could be more tightly controlled. In the first experiments, different kinds of items were involved in actions and incidents. For example, for the miner, the action involved a rock, whereas the incident involved a diamond. So perhaps higher possibility judgments for actions over incidents resulted from item effects (e.g., diamonds are rare, while rocks are common) rather than the difference between desired versus unintended events. Although we cannot conclusively rule out this concern, responses for individual events suggest it does not fully explain the findings (see Figures 1 and 2): Children affirmed possibility at comparable rates for the events involving the diamond and rock, even though diamonds are rarer. But children affirmed possibility much less for flowers, which are common. Also, the final experiment provides corroborating evidence that desires make events seem more possible, and it used a different design not subject to this concern.

It is also possible that our findings might be explained by alternative accounts. One alternative is that, rather than prompting memory, our design helped children better understand the test questions. Context often shifts how modal questions should be considered. For instance, consider the questions "Could we meet tomorrow at noon?" and "Could we meet tomorrow on Mars?" Both may elicit "no" responses but for very different reasons (Phillips & Kratzer, 2024). Children may interpret questions like "Could a person have a pet zebra?" as meaning something like "Could a typical person..." or "Under normal circumstances, could a person...". So, they might respond "no" for events that do not typically happen. On this account, our test questions helped clarify that we were not asking about what is typical.

We are skeptical about this account. One reason is that children's possibility denials persist even with questions that cannot be construed as asking about what is typical—questions like, "In real life, has someone ever had a pet zebra?" (Pabla et al., 2025) and questions about whether improbable events would require magic to happen (Nissel et al., 2024; Shtulman & Carey, 2007; Shtulman & Phillips, 2018). Further, children's possibility denials also largely persist when they are asked about contexts where expectations about what is typical should not hold, as when they are asked about what can happen in distant lands (Bowman-Smith et al., 2019) and about what will be possible in the future (Khan & Starmans, 2026).

Another alternative explanation for the findings is a purely associative account: Perhaps increased affirmations of possibility resulted because zookeepers are associated with zoo animals. It is unclear, though, why mere associations should affect judgments of possibility, and as far as we know, no one has yet offered an associative explanation for why children deny the possibility of improbable events. Associations also do not explain why children judged chosen actions as more possible than unintended incidents.

Even if an associative account turned out to be viable, it has much in common with the memory access proposal. On both accounts, specifying agents increases judgments of possibility by activating knowledge already possessed by the child. Even if children affirm possibility by considering circumstances behind events, this might not require detailed circumstances—considering skeletal circumstances might suffice. Recognizing that someone could have a pet zebra might require children to merely consider that some people like wild animals or that some people live near them, facts scarcely richer than associations. To get a clearer sense of whether children's judgments reflect causal knowledge or mere associations, future work could explore children's explanations and justifications. If children are able to explain *how* specific agents could produce improbable outcomes, this would support the causal knowledge account.

These questions aside, it is important to acknowledge that in our studies, children never affirmed possibility at ceiling rates, and while we did not analyze item effects, the figures suggest substantial variations across items. These results could stem from limits in children's knowledge and imaginations. Asking about related agents may only matter insofar as it helps children see circumstances behind events. But children might know relatively little about some agents or might know about them while still struggling to envision how they could be involved in the events. If so, we might see stronger effects of asking about related agents in older children. They know more and have greater imaginative abilities.

Alternatively, the limited effectiveness of asking about related agents could suggest that children's possibility denials are not fully explained by difficulty envisioning circumstances behind events; children's possibility judgments are likely impeded by other factors. In line with this, all other manipulations known to increase children's possibility judgments have also had limited effectiveness (Bowman-Smith et al., 2019; Khan & Starmans, 2026; Shtulman et al., 2024). This overall pattern could suggest that several factors prevent children from recognizing which events can happen, and these might vary across events. Children might conclude one event is impossible because they cannot envision circumstances that would produce it, but conclude another is

impossible because of its dissimilarity to known events. On this view, bringing children to affirm possibility at high rates might require combining manipulations together.

Conclusion

In sum, although children normally deny that improbable events can happen, they are more likely to affirm possibility for events that include agents who could plausibly be involved in them. This finding suggests that denials of improbable events arise, at least in part, because children fail to recall relevant causal and mentalistic knowledge that would allow them to envision how the events could be produced.

Data availability

Preregistrations, data, code, and power analyses can be downloaded at the Open Science Framework at: <https://osf.io/6dwm4/>

Author contributions

Brandon W. Goulding (Conceptualization, Formal analysis, Investigation, Methodology, Writing—original draft, Writing—review & editing [equal]), Samuel Ronfard (Conceptualization, Formal analysis, Investigation, Methodology, Writing—original draft, Writing—review & editing [equal]), and Ori Friedman (Conceptualization, Formal analysis, Investigation, Methodology, Writing—original draft, Writing—review & editing [equal])

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Conflicts of interest

The authors have no conflict of interest. Samuel Ronfard holds the position of consulting editor and did not participate in the peer review or make any editorial decisions for this manuscript.

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