British Journal of Developmental Psychology (2004), 22, 37–58

www.bps.org.uk

Exploring the coherence of young children's explanatory abilities: Evidence from generating counterfactuals

David M. Sobel*

Department of Cognitive and Linguistic Sciences, Brown University, USA

Researchers who advocate the hypothesis that cognitive development is akin to theory formation have also suggested that young children possess distinct systems for explaining physical, psychological, and biological principles (see, e.g., Wellman & Gelman, 1992). One way this has been investigated is by examining how children explain human action: Children explain intentional and accidental actions by appealing to psychological principles, and explain impossible physical or biological action in terms of the underlying principles of those domains (Schult & Wellman, 1997). The current investigation examined the coherence of children's explanatory systems by eliciting explanations of possible and impossible physical, psychological, and biological events. Then, in a separate set of stories, children were asked to generate counterfactual alternatives for characters who wanted to perform an event, but did not, either because of a mishap or because the event was impossible. Overall, children were better at generating explanations for why events were impossible than recognizing that no alternative could be generated for impossible events. However, there was some evidence that children's explanatory abilities predicted whether they could correctly reject cases where no counterfactual alternative could be generated. The results lend support to the hypothesis that children's causal knowledge is coherently organized in domain-specific knowledge structures.

Our knowledge of the world relies primarily on understanding the causal structure among events. We can make predictions about future events, provide explanations of past events, and reason about events that might have been. How does this understanding develop? Piaget (1929, 1930) suggested that young children lack a firm understanding of causal structure across various domains of knowledge, including biology, psychology, and physics. He observed that young children explained events in each domain by relying on principles from the other two. For example, they explained

* *Correspondence should be addressed to D. Sobel, Department of Cognitive and Linguistic Sciences, Box 1978, Brown University, Providence, RI, 02912 USA (e-mail: david_sobel_1@brown.edu)*

natural physical phenomena in terms of psychological principles, such as human intentions ('the clouds want to follow me'), and biological principles, such as strength ('the river isn't strong enough to flow upward').

Recent evidence, however, suggests that young children know a great deal about the causal structure of these three domains. Young children, and even infants, recognize that physical events have particular spatial and temporal relationships, and they recognize when these relations are violated (Baillargeon, Kotovsky, & Needham, 1995; Bullock, Gelman, & Baillargeon, 1982; Leslie & Keeble, 1987). Children reason about biological entities like animals and plants differently from other physical objects; they assign only biological entities the ability to grow, heal, and get sick (Inagaki & Hatano, 1993; Rosengren, Gelman, Kalish, & McCormick, 1991; Springer & Keil, 1991). Children categorize people, but not other physical entities, as having minds (Johnson & Wellman, 1982; Lillard, 1996), and they appeal to underlying causal principles like perceptions, desires, and beliefs to provide psychological explanations of human behaviour (Bartsch & Wellman, 1995; Perner, 1991; Wellman, Phillips, & Rodriguez, 2000).

This evidence has led many researchers to argue that young children understand causal structure in several core domains of thought: folk physics, folk psychology, and folk biology (e.g. Wellman & Gelman, 1992). Advocates of the 'theory theory' propose that knowledge of these core domains is represented by a set of theories, which children are born with and which they revise throughout development (Carey, 1985; Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1994; Keil, 1989; Wellman, 1990). Theories support abstract causal reasoning: they enable children to make predictions about future events, provide explanations of past events, and reason about counter-factuals (events that did not happen but could have).

Motivated by the hypothesis that children engage in theory formation, researchers have reexamined children's explanatory abilities. Schult and Wellman (1997; see also Wellman, Hickling, & Schult, 1997) investigated how children apply knowledge of folk physics, folk psychology, and folk biology to provide explanations of various types of human action. Similar to previous research (Shultz, Wells, & Sarda, 1980; Smith, 1978), which suggested that children explained human behaviour only by reference to psychological concepts, they found that young children did explain intentional actions and mistakes in terms of psychological principles. However, contrary to previous research, they also found that children explained impossible physical events—such as a character wanting to float in the air—in terms of physical principles (e.g. gravity), and impossible biological events—such as a character wanting to hang from a tree branch forever—in terms of biological principles (e.g. limb fatigue). They concluded that young children have at least three basic explanatory systems for providing explanations about physical, psychological, and biological events.

The goal of the present investigation is to examine the structure of these explanatory systems. Critically, advocates of the theory theory argue that the knowledge structures children use to provide explanations of events are coherent and counterfactual-supporting (Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1994). The present investigation examines this claim: do the three explanatory systems that Schult and Wellman (1997) investigated support counterfactual reasoning? Is there a relation between young children's ability to generate explanations in each domain and their ability to generate appropriate counterfactuals events—including their ability to recognize cases where no counterfactual is plausible?

This question is important in light of a broader question in cognitive development: How do children acquire causal knowledge? Some philosophers have suggested that new causal relations are learned by explicitly considering counterfactual alternatives (Lewis, 1973, 1986; Mackie, 1974). Indeed, even Hume, who argued that causal relations must be observed through regularity and associations, connected counterfactual reasoning with recognizing causal relations in his later writing: '... we may define a cause to be an object followed by another, and where all the objects similar to the first, are followed by objects similar to the second. Or, in other words, where if the first object had not been, the second never had existed' (Hume, 1748/1959).

Importantly, engaging in counterfactual thinking does not necessarily imply the presence of a causal relation. Kahneman and Tversky (1982) describe a classic example of counterfactual reasoning: While driving home from work, Mr Jones decides to take a route different from his normally travelled one. While driving on this route, another driver runs a red light and hits Mr Jones's car. In this example, determining the truth value of the counterfactual 'If only Mr Jones had taken a different route, he would not have gotten into an accident', does not imply that taking the chosen route directly caused the car accident. However, the truth value of the counterfactual, 'If only the other driver had stopped at the red light instead of running through it, the Mr Jones would not have gotten into an accident' does help confirm the presence of a direct causal relation between those two events. The philosophical argument, made by Lewis (1973, 1986) and others, is that causal relations are best understood as counterfactual statements: An interpretation of the statement *A causes B* is that *B would not have occurred if it were not for A*. Lewis's argument is that causal relations can be analysed in terms of counterfactuals, but not necessarily the other way around.

Do young children use counterfactuals when determining the presence of a causal relation? Empirical investigation suggests that young children can correctly reason about counterfactual events when they observe a causal relation. Harris, German, and Mills (1996) presented 3- and 4-year-olds with a sequence of events that resulted in a change in the state of the world. For example, children were shown a clean floor and a teddy bear that came in and walked across the floor in muddy boots, making the floor dirty. Children as young as 3 years old correctly stated that the floor would have been clean if Teddy had taken his boots off before he walked across the floor.

In a subsequent experiment, children were presented with stories in which a character made a decision that resulted in a mishap. In half the stories, the character decided between two options, either of which would have resulted in the same outcome (e.g. the outcome is having fingers covered in ink, and the options are using a black pen or using a blue pen). In the other half, the alternative would have prevented the mishap—the character simply chose the wrong option (e.g. using a black pen instead of a pencil). Children were asked why the mishap occurred, but also what could have prevented the mishap. Harris *et al.* (1996) found that children referred to the other choice the character could have made when it would have influenced the outcome (i.e. choosing the pencil over the pen), but ignored the offered alternative and referred to another action when the choice would have had no influence on the outcome.

While Harris *et al.* (1996) present convincing evidence that young children can engage in counterfactual reasoning after they directly observe a causal relationship, it is not clear whether this reasoning is related to a broader understanding of causal structure. For example, were children's answers to the causal 'why' question consistent with their answers to the counterfactual 'prevention' question? Harris *et al.* (1996) reported that children, especially 4-year-olds, answered the 'why' question in terms of a deviation from an implied norm—for example, choosing the effective option when it was presented, or choosing a correct alternative option when neither of the offered options would prevent a mishap. It is not clear, however, whether children's performance on the 'prevention' questions predicted their performance on the 'why' questions. If there is a direct link between young children's counterfactual reasoning and their understanding of causal relations, one would expect that performance on these questions would be correlated—if children understand what caused a mishap, they should also understand that changing that antecedent could (but would not necessarily) prevent the mishap.

The present investigation compared children's ability to generate explanations of events with their ability to reason about similar counterfactuals. As in Schult and Wellman (1997), children were asked to provide explanations of why characters could or could not engage in possible and impossible events across a variety of domains. In addition, the same children were asked to generate counterfactual alternatives for possible and impossible events in the same domains. The primary goal of this investigation is to examine whether children's explanatory systems are coherent: Are children equally capable of reasoning about counterfactual events as they are at generating explanations of similar events?

In addition, this investigation examines whether counterfactual reasoning is a general reasoning ability related to children's understanding of mental representation (Guajardo & Turley-Ames, 2001; Riggs, Peterson, Robinson, & Mitchell, 1998). For instance, Riggs *et al.* (1998) proposed that 3-year-olds' difficulty with the false-belief task is due to a more general deficit with counterfactual reasoning. To succeed on both false belief tasks and measures of counterfactual reasoning, children must make an inference based on a false representation of the world. Riggs *et al.* (1998) demonstrated that children were equally poor at responding to an 'unexpected transfer' task when the test questions were about mental states as when the questions were about the physical location of the objects.

This correlation, however, could be interpreted in one of two ways. It could be that children's ability to engage in counterfactual reasoning is independent of the content of that counterfactual. Under these circumstances, the process of counterfactual reasoning can be thought of as domain general. Alternatively, the ability to engage in counterfactual reasoning may differ among domains but is a function of how causal knowledge is represented. Thus, children should be able to engage in counterfactual reasoning in different domains at different points in development, dependent on their causal knowledge of that domain. Schult and Wellman (1997) specifically argue for the development of three separate explanatory systems, for folk physics, folk biology, and folk psychology. Their investigation revealed that children do indeed apply proper physical, biological, and psychological knowledge when asked to explain events in each domain. Yet, it remains unclear whether the way in which children represent that knowledge is coherent and counterfactual-supporting. Previous investigations have not addressed this issue: Both Harris *et al.* (1996) and Riggs *et al.* (1998) only investigated counterfactual reasoning about physical events. Sobel and Gopnik (2003) demonstrated that for two domains of knowledge (physical events and psychological events), only children who made accurate predictions about future hypothetical events were able to reason accurately about counterfactuals. These data provide some evidence for a coherent representation of causal knowledge—once children understand the causal structure of a domain, they can engage in both prediction and counterfactual reasoning. The present experiment examines whether the same relationship holds between counterfactual reasoning and explanation.

Experiment

The goal of the current investigation was to elicit explanations from children, following the procedure used by Schult and Wellman (1997), as well as to examine how the same children reasoned about counterfactual events in similar domains. Children were told stories about characters who wanted to perform particular actions, but failed. In some cases, the children were asked to explain why the character failed to perform the action. In others, children were told that the character was going to try again and were asked what the character could do differently to succeed. Some of the events involved simple mishaps; explanations and alternatives were easily accessible (although not specifically articulated, as in Harris *et al.*, 1996). Other stories involved a violation of biological, physical, or psychological principles (e.g. a child protagonist who never wanted to grow again, a character who wanted to jump up and float in the air, or a character who wanted to have no thoughts for a long time). Would children respond that nothing could be done differently to bring about the event? Further, would these same children correctly explain why these events were impossible?

Method

Participants

Eighteen 3-year-olds and sixteen 4-year-olds were recruited from a university preschool and a list of hospital births in an urban area. Three children in the 3-year-old sample were excluded for failing to meet minimum performance levels on control tasks (see below), leaving a sample of fifteen 3-year-olds ranging in age from 40 to 44 months (M = 42 months) and sixteen 4-year-olds, ranging in age from 48 to 59 months (M = 53 months). Approximately equal numbers of boys and girls participated. While most children were White and from middle-class backgrounds, a range of ethnicities resembling the diversity of the population was represented.

Materials

Two sets of 12 stories (see Appendix) were written out on 5 inch × 8 inch (12.70 cm × 20. 32 cm) blank white index cards. On the other side was a hand-drawn picture of a boy or girl—the character in the story. These pictures were of children not engaging in any action.

Procedure

All children were tested twice by the same experimenter. Children were brought into a quiet game room in either the school or the laboratory. They were told that they were going to play a game in which the experimenter would read some stories and ask them some questions. The experimenter then read 12 stories to the children (24 in total over the two sessions). On average, the sessions were approximately 3 days apart from one another, although some children were tested on the same day. The stories were presented in one of four quasi-random orders, counterbalanced across participants.

Following Schult and Wellman (1997), six of the stories in each session, the *explanation stories*, asked children to generate explanations of possible and impossible events. The possible stories were all about voluntary actions on the characters' part (e.g. a character who had been standing up wanting to lie down on his bed). The impossible stories required a violation of a natural physical law (e.g. a character wanting to jump up and float in the air), a psychological principle (e.g. a character wanting to sit and not have any thoughts for a long time), or a biological law (e.g. a child character who wanted never to grow taller). After the story was read to the participants, they were asked whether the character could perform the action; children were then asked to justify their response.

The other six stories in each session were *alternative stories*. Three of them were about characters who wanted to perform an action that was possible but failed to do so because of a mishap (e.g. wanted to play outside in the rain without getting his socks wet, but wore sneakers instead of boots). The other three were about characters who wanted to bring about an event that was impossible and failed to do so (e.g. wanting to jump up and float in the air). Children were asked what the character could do differently to bring about the event. If the child stated that the character could not do anything differently, the experimenter asked for a justification. If the child generated an alternative that was not part of the story, the experimenter reminded them of the story. For example, if the child said that the character who wanted to jump up and float in the air could do so if she had wings, the experimenter repeated the story and test question, reminding the child that the character did not have wings.

The possible explanation stories were all about voluntary actions on the character's part. They required physical (e.g. she can just jump up) or psychological (e.g. she chooses to have one juice over another) explanations. The other three story types—the impossible explanation stories, and both the possible and impossible alternative stories—were further divided into events that required knowledge of physical, psychological, or biological principles.

Coding

For the explanation stories, responses were coded for whether children provided a correct explanation of why the events in the story were possible or impossible. A 'correct' score meant that children correctly answered the yes/no 'Can you do that?' question and generated a plausible and relevant justification of this answer. For the alternative stories, responses were coded for whether children generated an alternative or observed that no alternative action was possible. If the child did propose an alternative, the response was coded as to whether performing the alternative action would result in the goal (note that this was not an option in the impossible alternative stories unless magic or pretense was invoked, see below). If the child said that no alternative was possible, then children were asked to justify their response. Then, following Schult and Wellman (1997), responses to each story were coded according to whether the explanation, alternative, or justification appealed to certain domain-specific principles, such as physical, psychological, and biological principles. This coding scheme is described in Table 1.

An important distinction to make is that not all physical, psychological, and biological explanations were coded as correct. Consider the following in response to the character who wants to stay awake forever:

C: If he gets sleepy and he lay down a little and then his mom won't find him.
E: If he gets sleepy and lays down a little then his mom won't find him. Good job.
C: Yeah, he'd stay awake forever. (Child's age: 48 months)

Table 1. Description of coding system (based on Schult & Wellman, 1997)

Code	Description	Examples
Physical	Explanations rely on physical forces such as gravity, solidity, or another mechanism for the action to be carried out.	Cause the ball is heavy and it will fall. She has to stop jumping. She has to go down cause you don't get to float in the air.
	Explanation suggested the presence or absence of a physical mechanism.	She needs some wings to do it.
	Explanation appealed to a physical act on the part of the character.	Not colour with the pencils, paint.
Biological	Explanations that appealed to a biological principle such as growth, sickness, inheritance, or pain.	Cause um if it got apple it get sick. Cause you have to grow and get bigger to be a big girl.
	Explanations that referred to the body or a biological processes within the body, such as eating or sleeping.	Because her legs can jump. You still get hurt—it goes through your skin.
Psychological	Explanation appealed to the character's mental states.	Cause he doesn't know where the bubble wand is. She could go to the zoo and find out what elephants are like.
	Explanations that appealed to the possession of mental faculties.	Because she has a brain and brains think.
	Explanations that appealed to a request on the part of the character.	Ask her mother to give her a piece of candy.
	Explanation that referred to a social standard or practice or rules that the character had to follow.	Because his mom and dad will get angry at him. Because he would get in trouble.
Magical	Explanations that postulate magic, a fictional character, or pretense.	Pretend he is a ghost and then he'll go in. Cause you need magic to turn a cat into a dog.
Other	Explanation was nonsensical or out of context, or simply did not fall into any of the other categories.	<In response to the story about a character who doesn't want to think> Because everybody's thing is different.
No Response/ I Don't Know	Self-explanatory.	

Note. All of the examples were generated by children in the present investigation.

This explanation was coded as a biological explanation. However, it clearly does not properly explain why a character could or could not stay awake forever. Similarly, children who rejected the fact that an alternative was possible did not always correctly justify their answers. In the following example, the character wanted to walk right through a fence:

C: He can't do anything, only rabbits can do it.
E: Why can rabbits do it?

C: Because they're, they're fat, but they, because, they're, they're scwunched, like, like a, like a, like a ball, they're like, like, they're like a ball, they can, they can, they can stick because they can go under, because rabbits are really tight.
E: The rabbits go under the fence? But Josh can't. So, why can't he do anything different?
C: Because rabbits only do it. (Child's age 49 months)

The stories were coded by an undergraduate research assistant, blind to the hypotheses of the experiment. A subset of the stories (192 out of the total 744, 26%) was coded by a second research assistant, also blind to the experimental hypotheses. Overall, agreement was 89%. Disagreements were discussed between the author and two research assistants, and final decisions were made by the author.

It is important to note that the coders were given only minimal instruction regarding what counted as a correct or incorrect explanation or alternative. On the explanation stories, they were instructed that correct responses should be both plausible and consistent with the story. On the alternative stories, they were instructed that correct responses should either generate plausible actions that would accomplish the character's goal in the possible stories, or generate adult-like justifications of why the character could not perform the action in the impossible stories. The fact that agreement levels were relatively high with only this minimal training suggests that this 'correct' coding reflected adult responses. For example, both the examples shown above were coded as incorrect: The first was off-target for the question; the second did not provide any reference to why the character could not walk through an object, or even that rabbits could 'pass through a fence' because they could dig under it (a very loose interpretation). One final note is worth making regarding this analysis: On some occasions, as noted by the coding scheme, responses appealed to pretence or magic. These responses were always coded as incorrect; children did not explicitly answer why a possible or impossible action was such, but rather appealed to a fantasy context. As can be seen in Table 3, however, these types of responses were relatively rare.

Probe questions

On many occasions, like the example above, children received probe questions to elicit more information or to clarify their answers. Across all children, of the 744 total stories, probe questions were given on 416 of them (56%). There were 613 probe questions in total. These probe questions fell into one of five categories: probes for more information (35%), repetition of story elements (49%), repetition of the child's utterance (3%), responses to an 'I don't know' response: 'Can you take a guess for me?' (8%), and probes about the plausibility of the child's utterance (5%). In many cases where probe questions were given, children often generated more than one utterance. For instance, this example is about a character who never wants to grow again:

E: KAREN STORY. What can she do different?
C: Not eating.
E: Not eating.
C: She ask her mom if she can't eat.
E: Well, what happens to you when you don't eat?
C: Um, you'll not grow.
E: You'll not grow. OK. (Child's age: 51 months)

In this case, the child was asked what a character could do differently to never grow again. Although the response involves a request, 'She'll ask her mom if she can't eat it', which were usually coded as psychological, this response was coded as providing a biological explanation. The most relevant feature of the explanation is that the child links not eating, a biological process, with not growing. The probe question, which asked for more information, allowed us to disambiguate whether each child recognized the domain-specific principle involved in each story.

Further, in some cases, probe questions were required to allow the experimenter to discern whether children were recognizing that no alternative could be generated, but were generating an alternative because of the demand characteristics of the question. For instance:

E: JOSH STORY. What can he do different?
C: He have to break the gate cause he doesn't fit in the lines.
E: Very good. But you know what, he wants to walk right through the fence. What can he do different to walk through the fence?
C: <shakes head no>
E: Nothing. Why not?
C: Because that all he could do.
E: Can you say more?
C: Because you can't go through the line. He's too big to go through the the little lines. (Child's age: 53 months)

This example, about a character who wanted to walk through a fence, was coded as correctly rejecting that an alternative could be generated, and correctly justifying that rejection, even though the child initially generated an alternative. One might argue that the predominance of probe questions, as in the example above, forced children to respond correctly. This predominance, however, was often due to children responding to the impossible alternative stories with a plausible counterfactual that did not address the issue present in the story. In the example above, the child generated a plausible alternative—that Josh would have to break the fence—as a way of stating that there was nothing the character could do to walk right through the fence. The experimenter took care not to probe until a correct answer was generated, and often stopped probing once an explanation or alternative for the particular question was generated. Overall, there was no difference between the number of probes given between the two age groups, between the explanation and alternative stories, or between any of the three story domains. If the experimenter was biased towards allowing the child to respond until they answered the question correctly, one might expect more probes on the impossible alternative stories. This was not the case. In stories where a probe was given, the average number of probe questions was 1.47.

Results

Overall, children were coded as correctly explaining why a character could engage in a voluntary action 91% of the time. Given this relatively high level of accuracy, performance on these stories was used as a measure of the child being on task. Since two of these stories were asked in each session, to be included in the further analysis, children must have explained at least one of these stories correctly in each session. Three of the 3-year-olds and none of the 4-year-olds were excluded for this reason.

The first analysis examined correct responses on each story type. A preliminary analysis was first done on the distribution of correct responses within each story type.

On one type of story, the impossible biological explanation stories, correct responses differed among the three stories, $\chi^2(2) = 13.56$, $p < .01$. This was potentially due to an outlier in the stories. Children had little difficulty in correctly explaining why a character could not get poked with a needle without pain or why a mommy cat could not have puppies (65% and 80%, respectively), but only 34% of children correctly explained why a character could not stop sneezing when she had a cold (see Appendix). It is possible that this story tested a different, and more sophisticated, aspect of biological knowledge than the other explanation (and alternative) stories. In this story, children must recognize that sneezing is an involuntary act. In the other stories (both the explanation and alternative stories), children must recognize that a particular biological process (i.e. growth, pain, sleeping, and inheritance) cannot be violated. There is some evidence that children do implicitly understand the nature of involuntary actions: Johnson and Wellman (1982) suggest that children understand that involuntary actions do not involve the mind. However, Smith (1978) demonstrated that 5-year-olds, but not 4-year-olds, recognized that sneezes were not intentional. Because of this, we felt that the most conservative course of action was to exclude responses to the Betty story from this analysis.

Table 2 shows the percentage of children who generated explanations coded as correct for each type of explanation story, who generated alternatives coded as correct in the possible alternative stories, and who were coded as claiming that no alternative was possible and correctly justified their response in the impossible alternative stories. Responses on the impossible stories were analysed by a 2 (Age: 3-year-olds vs. 4-year-olds) $\times$ 3 (Story domain: Physical, Psychological, vs. Biological) $\times$ 2 (Story type: Explanation vs. Alternative) mixed analysis of variance. Age was a between-subject factor; story domain and story type were within-subject factors. A main effect of story domain was found: Children responded differently to the three types of stories, $F(2, 58) = 9.54$, $p < .001$. A main effect of story type was also found: Children were better at explaining the impossible explanation stories than stating and justifying that no

Table 2. Percentage of stories each age group was coded as correctly explaining as a function of story type

Explanation stories	Imp. Physical	Imp. Biological	Imp. Psychological	Voluntary Actions
3-year-olds	58	67	37	87
4-year-olds	67	78	44	94
Alternative stories (possible actions)	**Physical**	**Biological**	**Psychological**	
3-year-olds	67	47	67	
4-year-olds	59	81	81	
Alternative stories (impossible actions)	**Physical**	**Biological**	**Psychological**	
3-year-olds	27	30	17	
4-year-olds	31	38	34	

alternative was possible in the impossible alternative stories, $F(1, 29) = 27.58, p < .001$. There was no main effect of age. Further, a significant story type by story domain interaction was found, $F(2, 58) = 3.62, p < .05$.

Performance on the three story domains was then examined. On the explanation stories, children explained more impossible physical and biological stories than impossible psychological stories, $t(1, 30) = 2.78$ and 5.61, respectively, both *p*-values < .01. There was no difference, however, between performance on the impossible physical and impossible biological stories. On the alternative stories, children showed no difference between their ability to explain any of the three story domains. Children were more inclined to correctly explain the explanation stories than to correctly reject and justify the alternative stories for the impossible physical stories, $t(1, 30) = 5.01$, $p < .001$, and the impossible biological stories, $t(1, 30) = 3.48$, $p < .005$, but only showed a trend to do so for the impossible psychological stories, $t(1, 30) = 1.72, p < .10$.

A second analysis was done to examine the responses to the possible and impossible alternative stories. A 2 (Age: 3-year-olds vs. 4-year-olds) × 3 (Story domain: Physical, Psychological, vs. Biological) × 2 (Possibility: Possible vs. Impossible) mixed analysis of variance was performed with age as a between-subject factor, and domain and possibility as within-subject factors. Only a main effect of possibility was significant; children were more likely to provide correct alternative events in the possible stories than to correctly observe that no alternative was possible in the impossible stories, $F(1, 29) = 35.78$, $p < .001$. No other significant main effects or interactions were found.

Table 3 shows the distribution of physical, psychological, biological, and other explanations that children generated for each story type. A preliminary analysis revealed that the distribution of codes (shown in Table 1) for responses within a story type did not differ for any of the physical or biological stories, or for the impossible psychological explanation stories. However, within both the possible and impossible psychological alternative stories, the distribution of codes did differ between the two stories, $\chi^2(4) = 24.78, p < .001$, and $\chi^2(3) = 10.57, p < .05$, respectively. In both cases, this result was due to responses to one story being predominantly coded as psychological and responses from the other story being split between psychological and physical: On the possible story in which Alison wants the candy from the locked box, a group of children responded that she could break open the box—a physical response. Likewise, on the impossible story in which Danny wants his ignorant dad to tell him where his bubble wand is, a group of children responded that Danny could look for the wand himself—also coded as a physical response. Again, we felt that the most conservative reaction to this analysis would be to exclude these two stories from further analyses.

On the explanation stories, children explained stories about impossible actions in each domain in terms of that domain; children used physical principles to explain the impossible physical stories more often than in any other category: Binomial test, $p < .05$; this held true for the psychological and biological stories as well: Binomial tests, both *p*-values < .05). Further, there was no effect of age: 3- and 4-year-olds showed the same pattern of responses on each story type. Responses to the alternative stories showed a similar pattern of performance, with one exception: An age difference was found on the impossible psychological stories. The distribution of responses differed between the 3- and 4-year-olds: $\chi^2(3) = 7.94$, $p < .05$; more 4-year-olds generated psychological responses than 3-year-olds.

Next, an analysis was done to examine whether children generated domain-

Table 3. Percentage of stories each age group explained by appealing to individual processes as a function of story type, possibility, and domain

	Explanation stories					
	IDK/NR	Physical	Psychological	Biological	Magical	Other
Imp. Physical						
3-year-olds	0	71	11	2	4	11
4-year-olds	4	71	13	8	0	4
Imp. Psychological						
3-year-olds	3	13	63	3	0	17
4-year-olds	3	22	53	13	0	9
Imp. Biological						
3-year-olds	0	6	18	64	0	11
4-year-olds	4	8	10	71	2	1
Voluntary Actions						
3-year-olds	2	82	13	2	0	2
4-year-olds	2	78	14	3	0	2
	Alternative Stories					
	IDK/NR	Physical	Psychological	Biological	Magical	Other
Pos. Physical						
3-year-olds	3	90	7	0	0	0
4-year-olds	3	91	0	3	0	3
Pos. Psychological[a]						
3-year-olds	6	20	67	0	0	7
4-year-olds	0	0	100	0	0	0
Pos. Biological						
3-year-olds	3	17	7	70	0	3
4-year-olds	0	9	3	84	0	3
Imp. Physical						
3-year-olds	3	67	13	10	3	3
4-year-olds	0	88	6	0	0	6
Imp. Psychological[a]						
3-year-olds	7	20	60	0	0	13
4-year-olds	0	0	100	0	0	0
Imp. Biological						
3-year-olds	3	23	23	40	0	10
4-year-olds	3	9	16	63	0	9

[a]Responses are based only on one story.

appropriate responses when their response was coded as incorrect. Table 4 shows the distribution of codes that children appealed to when they generated incorrect explanations and alternatives. When children responded incorrectly on the explanation stories, they did so by appealing to various other domains. This suggests that when children incorrectly explained these stories, it was not because they applied information about that domain incorrectly, but rather that they chose to explain the story by appealing to principles in another domain or by choosing to appeal to principles not identifiable as physical, psychological, or biological.

Table 4. Percentage of stories each age group incorrectly explained by appealing to individual processes as a function of story type, possibility, and domain

	Explanation stories					
	IDK/NR	Physical	Psychological	Biological	Magical	Other
Imp. Physical						
3-year-olds	0	37	26	5	5	26
4-year-olds	13	31	38	6	0	13
Imp. Psychological						
3-year-olds	5	21	47	5	0	21
4-year-olds	6	39	33	6	0	17
Imp. Biological						
3-year-olds	0	11	26	37	0	26
4-year-olds	11	6	17	50	6	11
Voluntary Actions						
3-year-olds	13	50	13	13	0	13
4-year-olds	50	25	0	0	0	25
	Alternative stories					
	IDK/NR	Physical	Psychological	Biological	Magical	Other
Pos. Physical						
3-year-olds	10	80	10	0	0	0
4-year-olds	8	77	0	8	0	8
Pos. Psychological[a]						
3-year-olds	20	40	20	0	0	20
4-year-olds	0	0	100	0	0	0
Pos. Biological						
3-year-olds	6	25	13	50	0	6
4-year-olds	0	33	0	50	0	17
Imp. Physical						
3-year-olds	5	64	18	5	5	5
4-year-olds	0	82	9	0	0	9
Imp. Psychological[a]						
3-year-olds	9	18	55	0	0	18
4-year-olds	0	0	100	0	0	0
Imp. Biological						
3-year-olds	5	29	33	24	0	10
4-year-olds	5	15	25	40	0	15

[a]Responses are based only on one story.

In contrast, on the alternative stories, children showed a different pattern of responses. On the physical stories, children of both age groups overwhelmingly generated alternatives that appealed to physical processes when they incorrectly responded to both the possible and impossible physical stories: Binomial tests, both *p*-values < .05. On the biological and psychological stories, responses differed by age. Three-year-olds showed no signs of systematic responding. Four-year-olds, in contrast, were likely to explain the story by appealing to processes relevant to the domain, even when their responses were incorrect.

Finally, an analysis was done to examine whether responses on the alternative stories were predicted by responses to the explanation stories. To ensure that any relationship observed here was not simply due to other developmental factors, such as language ability, age was factored out of these analyses. Overall, the total number of impossible explanation stories children correctly explained predicted the number of impossible alternative stories they correctly rejected: $r(28) = 0.31$, $p < .05$ (one-tailed). These relationships were then considered on each individual story type. On the physical stories, the number of impossible explanation stories children correctly explained correlated with the number of impossible alternative stories children correctly rejected and justified, when age was first factored out of the model: $r(28) = 0.31$, $p < .05$ (one-tailed). In the individual biological stories, this relationship demonstrated a trend towards significance: $r(28) = 0.30$, $p < .06$ (one-tailed). The psychological stories, however, did not demonstrate this relationship.

Discussion

Children were presented with stories and questions that probed the coherence of their explanatory abilities. In some stories, 3- and 4-year-olds were asked to provide explanations of possible or impossible events. The impossible events violated an underlying principle of physical, psychological, or biological causality. Other stories in the same three domains asked children to provide an alternative action that a character could take that would result in accomplishing a possible or impossible task. In these cases, to be counted as correct, children had to either generate a plausible counterfactual event, or respond that no alternative was possible and had to justify that response.

Children were able to provide explanations for impossible physical, biological, and psychological events. They were also able to generate proper counterfactual alternatives for possible events in each domain. In contrast, they had difficulty correctly stating that no counterfactual alternative was possible for the impossible events in each domain. Performance, however, was not at floor: Even some 3-year-olds were able to correctly respond that characters could do nothing differently when they wanted an impossible physical, psychological, or biological event to occur.

In the stories about impossible physical events, how children performed on the explanation stories predicted whether they would correctly observe that no alternative was possible. Performance on the biological stories showed a trend in this direction. This suggests that the systems children possess to represent causal knowledge in these domains are coherent. The psychological stories, in contrast, did not show this relationship—there was no relationship between how children answered the impossible psychological explanation questions and how they responded to the impossible psychological alternative stories. Critically, in both the physical and, to an extent, the biological stories, children demonstrated coherent, domain-specific knowledge that enabled them to engage in both explanation and counterfactual reasoning.

However, this does not imply that children's knowledge of folk psychology is not coherently organized. The physical and biological explanation and alternative stories specifically asked about similar principles (e.g. gravity and growth). In contrast, there was an important difference between the impossible psychological explanation and alternative stories. The impossible psychological explanation stories were all about whether children understood the automaticity of mental activity (e.g. that a character could not stop thinking even if she wanted to). Several investigations, notably Flavell, Green, and Flavell (1995), have shown that the majority of young children do not recognize that mental states like thinking are not completely under one's own control. These investigations suggest that it is only at age 8 that children begin to have an adult-like understanding of mental activity. Therefore, it is possible that many children did not have the necessary understanding to answer these questions correctly. The impossible psychological alternative stories, in contrast, were about whether children understood mental representation (e.g. that a character who had no knowledge of an event could tell another character the details of that event). For example, investigations by Lillard (see, e.g., Lillard, 1996) suggest that these abilities have a developmental path similar to understanding mental activity. These two principles might not have been similar enough to tap the same developing knowledge structure.

When children incorrectly responded to the explanation stories, they appealed primarily to principles in another domain of knowledge, or to principles not identifiable as physical, psychological, or biological. Children did not apply knowledge about particular domains broadly—they did not simply identify that the story was about physical knowledge and then generate a folk-physical explanation. Instead, their errors seemed to be on a more global level—they generated explanations across domains. There are two ways to interpret this finding. The first is similar to the manner in which Piaget (1929, 1930) interpreted children's performance on his interviews—he suggested that young children simply confused physical, psychological, and biological phenomena. Alternatively, it could be the case that children's errors indicate that their knowledge structure of each domain is not fully developed. The latter interpretation is consistent with another finding in these data: Success in generating domain-specific explanations correlates with correctly recognizing that no alternatives could be generated for the impossible alternative stories.

A proposal made in the adult counterfactual reasoning literature is relevant here. Seelau, Seelau, Wells, and Windschitl (1995) propose that counterfactuals generated by adults come from a set of propositions about the world that specifically do not break physical laws of the universe (see also Cheng & Novick, 1990, 1992; Harris, 2000). For example, consider the counterfactuals generated after an airplane crash. While it is possible to generate 'if only there was no gravity, the plane wouldn't have crashed' as a potential counterfactual, doing so is invalid in adult reasoning, as it is not possible to modify this particular antecedent in the physical world. Therefore, adults will automatically reject the possibility of generating such a counterfactual. This proposal implies that the child's understanding of causal structure (not necessarily just in the physical domain) influences the types of counterfactuals they produce. Only children who can properly explain that gravity is always present in the airplane crash example should correctly reject such a counterfactual.

If children's understanding of causal structure is coherent, why is there a difference between performance on the impossible explanation and impossible alternative stories? There is an important difference in the cognitive abilities required to respond correctly to the two stories. The first requires simply providing an explanation, the second requires inhibiting the desire to answer the question—the initial question children were asked was, 'What can he do different?' and not, 'Can he do anything different?' Three-year-olds and many 4-year-olds have difficulty with measures of executive function and inhibitory control (see, e.g., Carlson, Moses, & Hix, 1998). It is quite possible that many of the younger children simply generated implausible alternatives because they interpreted the question as asking for an alternative.

One piece of anecdotal evidence confirms this hypothesis. Consider two cases in which children both correctly responded that there is nothing the character can do to get her grandpa, who does not know about elephants to tell her about them:

E: ANNA STORY. What can she do different?
C: What she needs to go to the zoo and see what an elephant looks like.
E: Oh right, but before she goes to the zoo, what can Anna do different to get her grandpa to tell her about elephants?
C: He just can't.
E: Oh, why not?
C: Because he just can't.
E: Why not?
C: Because if he never been to the zoo, he doesn't know what an elephant looks like. (Child's age: 43 months)

E: ANNA STORY. What can she do different?
C: She can't do different if no one else knows about elephants. (Child's age: 49 months)

The first response was typical of 3-year-olds who correctly recognized that nothing could be done. They often generated an alternative that introduced a novel event to the story, requiring the experimenter to generate one or more probe questions that eventually led the child to suggest that the character could do nothing different. However, the younger children rarely responded like the 4-year-old in the second example, who explicitly suggested that the character could do nothing different. Importantly, this was not simply because the younger children required more probe questions—there was no difference between the number of probes questions given to the 3- and 4-year-olds on the impossible alternative stories (mean: 1.31 per story).

Given this possible difference between the 3- and 4-year-olds, it would be interesting to examine results from older children, who may not have such difficulties with inhibition, to see if differences between the explanation and alternative stories exist. One might expect that by age five or six, children would not show such a difference on the explanation and alternative stories but would still show similar correlations between the two. For the most part, the material in the physical and biological stories posed few problems for preschoolers. In contrast, most 3- and 4-year-olds might not completely understand the causal structure of the psychological domain. Three-and 4-year-olds do not perform at ceiling on the false-belief task (Wellman, Cross, & Watson, 2001; Wimmer & Perner, 1983), nor do they perform at ceiling on other tasks that involve understanding mental representation and mental activity (Carpendale & Chandler, 1996; Flavell, Green, & Flavell, 1995; Johnson & Wellman, 1982; Lillard, 1996). Examining the performance of older children, who have a better understanding of the causal structure of this domain, might reveal a greater correlation between performance on the explanation and alternative stories.

However, even the youngest children in the current investigation were relatively accurate at generating counterfactual events when appropriate. These findings are at odds with the view that counterfactual reasoning is a domain-general ability responsible, for example, for young children's failure on false-belief tasks (e.g. Riggs *et al.*, 1998). Three-year-olds accurately generated possible counterfactual events when they were called upon to do so and, in some cases, appropriately responded that no counterfactual was possible. Instead, this finding lends support to the hypothesis that counterfactual reasoning is a domain-specific ability, and a functional feature of how children represent their causal knowledge. The explanatory structures posited by

Schult and Wellman (1997) could be construed as such a representation (see also Gopnik & Meltzoff, 1997; Sobel & Gopnik, 2003).

In conclusion, the analysis presented here further demonstrates that children's understanding of causal structure is coherent. Children showed an overall relationship between the ability to provide explanations of impossible events and the ability to correctly perceive that no counterfactual could be generated for impossible events. This suggests that children organize their knowledge about these particular domains using a theory-like structure, which allows for prediction, explanation, and counterfactual reasoning. The present findings do not suggest that young children have the same level of explanatory ability that adults do. However, the findings do suggest that as young children develop a more adult-like understanding of causal structure, that understanding will be organized in a coherent manner.

Acknowledgements

This work was made possible in part by a National Research Service Award (#F31-MH-12047). I wish to thank Maxim Abelev, Sara Baldi, Sierra Beck, Caroline Fill, and Meghan Harris for help with the data collection and analysis, Julie Chi for help designing the stimuli, and Alison Gopnik, Amy Hoff, David Lagnado, Molly Losh, Michael Ranney, Laura Schulz, and Dan Slobin for feedback on this manuscript.

References

Baillargeon, R., Kotovsky, L., & Needham, A. (1995). The acquisition of physical knowledge in infancy. In D. Sperber, D. Premack, & A. J. Premack (Eds.), *Causal cognition: A multidisciplinary debate* (pp. 79–116). New York: Clarendon Press/Oxford University Press.

Bartsch, K., & Wellman, H.M. (1995). *Children talk about the mind*. New York: Oxford University Press.

Bullock, M., Gelman, R., & Baillargeon, R. (1982). The development of causal reasoning. In W. J. Friedman (ed.), *The developmental psychology of time* (pp. 209–254), New York: Academic Press.

Carey, S. (1985). *Conceptual change in childhood*. Cambridge, MA: MIT Press/Bradford Books.

Carlson, S. M., Moses, L. J., & Hix, H. R. (1998). The role of inhibitory processes in young children's difficulties with deception and false belief. *Child Development*, *69*, 672–691.

Carpendale, J. I., & Chandler, M. J. (1996). On the distinction between false belief understanding and subscribing to an interpretive theory of mind. *Child Development*, *67*, 1686–1706.

Cheng, P. W., & Novick, L. R. (1990). A probabilistic contrast model of causal induction. *Journal of Personality and Social Psychology*, *58*, 545–567.

Cheng, P. W., & Novick, L. R. (1992). Covariation in natural causal induction. *Psychological Review*, *99*, 365–382.

Flavell, J. H., Green, F. L., & Flavell, E. R. (1995). Young children's knowledge about thinking. *Monographs of the Society for Research in Child Development*, *60* (1, Series No. 243).

Gopnik, A., & Meltzoff, A. (1997). *Words, thoughts and theories*. Cambridge, MA: MIT Press.

Gopnik, A., & Wellman, H. M. (1994). The theory theory. In L. Hirschfield & S. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 257–293). Cambridge, MA: MIT Press.

Guajardo, N. R., & Turley-Ames, K. J. (2001). *Theory of mind and counterfactual reasoning: Mutating the antecedent vs. the consequence*. Paper presented at the 2001 Biennial meeting of the Society for Research in Child Development, Minneapolis, MN.

Harris, P. L. (2000). *The work of the imagination*. Malden, MA: Blackwell.
Harris, P. L., German, T., & Mills, P. (1996). Children's use of counterfactual thinking in causal reasoning. *Cognition, 61*, 233–259.
Hume, D. (1748/1958). *An enquiry concerning human understanding*. Reprinted by Open Court Press (LaSalle, IL).
Inagaki, K., & Hatano, G. (1993). Young children's understanding of the mind-body distinction. *Child Development, 64*, 1534–1549.
Johnson, C. N., & Wellman, H. M. (1982). Children's developing conceptions of the mind and brain. *Child Development, 53*, 222–234.
Kahneman, D., & Tversky, A. (1982). The simulation heuristic. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 201–208). New York: Cambridge University Press.
Keil, F. (1989). *Concepts, kinds, and cognitive development*. Cambridge, MA: MIT Press.
Leslie, A. M., & Keeble, S. (1987). Do six-month-old infants perceive causality? *Cognition, 25*, 265–288.
Lewis, D. (1973). *Counterfactuals*. Cambridge, MA: Harvard University Press.
Lewis, D. (1986). *Philosophical papers* (Vol. II). New York: Oxford University Press.
Lillard, A. S. (1996). Body or mind: Children's categorizing of pretense. *Child Development, 67*, 1717–1734.
Mackie (1974). *The cement of the universe: A study of causation*. Oxford: Oxford University Press.
Perner, J. (1991). *Understanding the representational mind*. Cambridge, MA: MIT Press.
Piaget, J. (1929). *The child's conception of the world*. London: Routledge & Kegan Paul.
Piaget, J. (1930). *The child's conception of physical causality*. London: Routledge & Kegan Paul
Riggs, K. J., Peterson, D. M., Robinson, E. J., & Mitchell, P. (1998). Are errors in false belief tasks symptomatic of a broader difficulty with counterfactuality? *Cognitive Development, 13*, 73–90.
Rosengren, K. S., Gelman, S. A., Kalish, C. W., & McCormick, M. (1991). As time goes by: Children's early understanding of growth in animals. *Child Development, 62*, 1302–1320.
Schult, C. A., & Wellman, H. M. (1997). Explaining human movements and actions: Children's understanding of the limits of psychological explanation. *Cognition, 62*, 291–324.
Seelau, E. P., Seelau, S. M., Wells, G. L., & Windschitl, P. D. (1995). Counterfactual constraints. In N. J. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 57–79). Majwah NJ: Erlbaum.
Shultz, T. R., Wells, D., & Sarda, M. (1980). Development of the ability to distinguish intended actions from mistakes, reflexes, and passive movements. *British Journal of Social and Clinical Psychology, 19*, 301–310.
Smith, M. (1978). Cognizing the behavior stream: The recognition of intentional action. *Child Development, 49*, 736–743.
Sobel, D. M., & Gopnik, A. (2003). *Causal prediction and counterfactual reasoning in young children: Separate or similar processes?* Manuscript submitted for publication, Brown University.
Springer, K., & Keil, F. C. (1991). Early differentiation of causal mechanisms appropriate to biological and nonbiological kinds. *Child Development, 62*, 767–781.
Wellman, H. M. (1990). *The child's theory of mind*. Cambridge, MA: Bradford Books/MIT Press.
Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development, 72*, 655–684.
Wellman, H. M., & Gelman, S. A. (1992). Cognitive development: Foundational theories of core domains. *Annual Review of Psychology, 43*, 337–375.
Wellman, H. M., Hickling, A. K., & Schult, C. A. (1997). Young children's psychological, physical, and biological explanations. In H. M. Wellman & K. Inagaki (Eds.), *The core domains of thought: Children's reasoning about physical, psychological, and biological phenomena* (pp. 7–25). San Francisco, CA: Jossey-Bass.

Wellman, H. M., Phillips, A. T., & Rodriguez, T. (2000). Young children's understanding of perception, desire, and emotion. *Child Development*, *71*, 895–912.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, *13*, 103–128.

Received 18 January 2002; revised version received 3 March 2003

Appendix: Script of stories used in the investigation (some stories are directly from Schult & Wellman, 1997)

Impossible physical explanation stories

This is Jack. Jack is playing with a ball. He throws the ball up into the air and it comes down and he catches it. Every time he throws the ball up in the air, it comes back down again. Now he wants it different. He wants to throw the ball up and have it float in the air, not touching anything. Can that happen? Why/Why not?

This is Greg. Greg is playing with a puzzle. He arranges all the pieces of the puzzle just so to make a picture. But now he wants it different. He wants to squish all the puzzle pieces together like play-doh. The pieces would still be there, but they would squish together. Can he do that? How can he do that?/How come?

This is Gary. Gary is looking at the fish tank. He sees the fish swimming around. He looks and looks at the fish through the glass. Now he wants it different. He wants to stick his hand through the glass and touch the fish. The glass would still be there, but his hand would pass right through. Can he do that? How can he do that?/How come?

Impossible biological explanation stories

This is Henry. Every time Henry gets poked with a needle it really hurts. The needle pokes him and ouch, does it hurt. Now, he wants to have it different. He wants it so when he gets poked it won't hurt. He'd still get poked with the needle, but it would never hurt. Can that happen? Why/Why not?

This is Betty. Betty has a cold. Every time Betty has a cold she always sneezes. She sneezes and sneezes. Achoo. Now she wants it different. She wants it so that she would never sneeze again. She would still have a cold, but she would never sneeze. Can she do that? How can she do that/How come?

This is Rachel. Rachel has a pet cat. She loves her cat very much. She also loves dogs. Rachel's cat is going to have babies. Her cat is going to have kittens. Now she wants it different. Rachel wants her cat to have puppies. Her cat would still have babies, but they would be baby dogs. Can that happen? Why/Why not?

Impossible psychological explanation stories

This is Claire. Claire is sitting in the car on the way to the store. She is watching the trees and thinking about what lives in the trees. She is also thinking about her mommy who is driving the car. And she is thinking about what she is going to buy at the store. Now she wants it different. She wants to not think about anything. She wants to sit and not have any thoughts at all for a long time. Can she do that? How can she do that?/How come?

This is Anne. Anne is at home with her mom. Her mom is talking and telling her to help clean up her room. Anne hears what he mom says. Now she wants it different. She wants it so that she cannot hear what her mom says. Her mom would still say things to Anne, but Anne would not hear them. Can she do that? How can she do that?/How come?

Voluntary actions—possible explanation stories

This is Cathy. Cathy has been sitting outside on a bench for a long time. She's been sitting quietly watching the trees. Now she wants something different. She wants to stop sitting and start jumping up and down. Can she do that? How can she do that?/How come?

This is Fred. Fred is in his room standing with his feet on the floor. He's been standing up a long time. Now he wants it different. He wants to stop standing up and lie down on his bed. Can he do that? How can he do that?/How come?

This is Mike. Mike paints a picture every day at school. He uses the paints and brushes to paint a picture every day. Now he wants to have it different. He wants to stop painting pictures and start coloring with crayons. Can he do that? How can he do that?/How come?

This is Susan. Susan drinks orange juice every morning with her breakfast. Her mom has lots of different juices to choose from, but she always drinks orange juice. Now she wants it different. She wants to stop drinking orange juice and start drinking apple juice. Can she do that? How can she do that?/How come?

Impossible physical alternative stories

Jenny is jumping up and down. Each time she jumps in the air, she always comes back down to the ground. Now she wants it different. She wants to jump up and just float in the air, not touching anything. So she thinks real hard and jumps up, but comes right back down to the ground. Now she's going to try again. What can she do different?

Josh wants to play in Mr Johnson's garden. Mr Johnson is very mean and doesn't like children playing in his garden so he put up a big fence around his garden. Josh tried to climb the fence, but it was too high. Now he wants it different. He wants to walk right through the fence. The fence would still be there, but he would just ooze through it. So he thinks real hard and walks to the fence, but he can't walk through it, he hits his head. So he's going to try again. What can he do different?

Impossible biological alternative stories

Bobby is staying up late, past his bedtime. He really likes staying up and wants to stay awake forever. So he thinks real hard, but soon, Bobby gets really sleepy and goes to sleep. The next night, Bobby also wants to stay awake forever so he's going to try again. What can he do different?

Karen is (4) years old, just like you. Her mom measures how tall she is and every year, she gets bigger. She keeps growing and growing. But this year, she wants it different. She doesn't ever want to grow again. She wants to stay the same size forever. So she thinks really hard, but when her mom measures her, she's grown. Now she's going to try again. What can she do different?

Impossible psychological alternative stories

Danny wants to blow bubbles, but he can't find his bubble wand. So he goes and asks his dad. But, his dad does not know where Danny's bubble wand is. His dad did not see Danny's bubble wand so he says, 'I don't know'. But Danny still wants his dad to tell him where his wand is, so he's going to try again. What can he do different?

Anna is going to go to the zoo. She has never seen an elephant before. Anna wants to know what an elephant looks like. So she asks her grandpa. But her grandpa has never seen an elephant and does not know what an elephant looks like. So she asks her grandpa, but her grandpa says, 'I don't know'. But Anna still wants her grandpa to tell her about elephants, so she's going to try again. What can she do different?

Possible physical alternative stories

Marc wants to go out and play in the rain. He has a lot of different kinds of shoes, so he runs outside with his sneakers on. But when he comes in from playing his socks are all wet. Yuck. The next day it's also raining and he wants to play in the rain so he's going to try again. What can he do different?

Maya wants to play at the art table. There are lots of different art supplies at the art table, so she decides to color with a pen. But when she finishes, her fingers are all inky. Yuck. The next day, she wants to play at the art table again, so she's going to try again. What can she do different?

Possible biological alternative stories

Rebecca has a fish at home. She wants to take good care of the fish, so she runs and feeds the fish an apple and the fish gets sick. Yuck. The next day, Rebecca also wants to take care of the fish, so she's going to try again. What can she do different?

Billy is out on a walk with his school. During the walk, he sees some berries on a tree. Billy is hungry and wants to eat the berries, so he does. Billy gets sick. Yuck. The next day, Billy is also hungry and he knows he's going to go on a walk. What can he do different?

Possible psychological alternative stories

Alison is hungry. She wants a piece of candy. She sees her mom put some candy in a box on the table. So she goes to the box, but the box is locked. But she still wants the candy, so she's going to try again. What can she do different?

Charlie is going to the circus. He has never been to the circus before and wants to know about the clowns. So he asks his mom. His mom has been to the circus and knows all about clowns. But his mom is on the telephone and when Charlie asks, she says, 'I can't tell you because I'm on the telephone'. But Charlie still wants his mom to tell him about clowns, so he's going to try again. What can he do different?