Reasoning about make-believe and hypothetical suppositions: Towards a theory of belief-contravening reasoning

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Abstract

The present study explores how suppositions which conflict with accepted beliefs are represented and reasoned about. Two studies test the predictions regarding the nature and developmental changes in children’s ability to represent and reason about hypothetical or make-believe suppositions which violate their everyday knowledge and beliefs. In Study 1, 46 4th- and 5th-graders were introduced to a hand puppet, Freddy, who made claims inconsistent with generally accepted beliefs (e.g., “all dogs meow”) because he was pretending (Make-Believe Condition) or believed them (Hypothetical Condition). Participants were asked to think like Freddy and judge whether a conclusion (“There’s a dog; does it meow?”) follows logically from the claim. In Study 2, 40 kindergarten (6-year-olds), 3rd–4th grade (10-year-olds), and college students were asked to represent belief contravening make-believe (pretend in a make-believe world that dogs meow) and hypothetical (imagine what the real world would be like if dogs meow) premises, evaluate conclusions of the premises (Rover is a dog, does Rover meow?) and make judgments about the attributes (growl, wag tail, purr, and eat mice) of the entity (a meowing dog) they created. The prediction that it would be easier to represent and reason from belief-contravening suppositions in the Make-Believe than Hypothetical conditions was confirmed in each study, although the two forms of reasoning were directly correlated (Study 2). The results were discussed in terms of the similarities (compartmentalization and integration) and differences (reconciliation) of processes involved in fancifully (make-believe) or seriously (hypothetical) representing and reasoning about belief-contravening suppositions.

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1. Introduction

Children hear and tell all kinds of make-believe stories in the course of a day, whether the stories are enacted in the context of socio-dramatic or pretend play or imagined in the context of story-telling or book reading. As noted by others, research on children’s pretend play and fictional narrative comprehension and production skills is largely independent of each other, but seems to have many common underlying connections (Bruner, 1990; Kavanaugh & Engle, 1998; Nicolopoulou, in press; Pellegrini & Galda, 1993; Trionfi, 2005). One source of commonality between these cognitive activities and a focus of this paper is that regardless of the context in which they are produced or comprehended, make-believe stories involve reference to states of affairs which violate the children’s beliefs about the real world. Whether pretending or hearing a fairy tale about a princess of a far-away kingdom, the child must represent and reason about the princess, despite such propositions violating what she knows or believes to be true about the existence of the princess or her kingdom.

The present paper explores the nature and development of children’s ability to engage in belief-contravening reasoning. According to the philosopher Nicholas Rescher (1961, 1964), the states of affairs (including events, characters, actions, objects, etc.) that are referred to in make-believe stories are treated as suppositions which contravene beliefs in a person’s network of accepted beliefs. Because they are marked as suppositions, beliefs about the make-believe pretend or fictional states of affairs are distinguished from accepted beliefs. But to Rescher, the challenge of belief-contravening reasoning lies not with the suppositions being distinguished from accepted beliefs, but rather with reconciling the suppositions with a network of accepted beliefs with which they conflict. That is, although the story about the princess of a magical kingdom may be a supposition, to make sense out it, the supposition must be reconciled with accepted real-world beliefs about princesses, such as that they are royalty who live in palaces, despite believing that the particular princess and her kingdom do not exist.

Some of Rescher’s philosophical claims are well supported by psychological research. One such well-supported claim is that make-believe suppositions in pretend play or fictional narratives can be competently entertained even though they are false. Even young children appear to have a firm grasp on the difference between real and make-believe (pretend or imagined) states of affairs at a very young age (Estes, Welman, & Woolley, 1989; Harris, Brown, Marriott, Whittall, & Harmer, 1991; Sharon & Woolley, 2003; Woolley & Wellman, 1993), although a variety of factors may conspire to affect their judgments (Amsel, Bobadilla, Coch, & Remy, 1996; Bourchier & Davis, 2000, 2002; Harris et al., 1991; Samuels & Taylor, 1994). Indeed, children understand that enactments or stories pragmatically framed as make-believe are not about the real world (Dias & Harris, 1988; 1990; Harris & Kavanaugh, 1993; Lillard & Witherington, 2004; Woolley & Bruell, 1996).

It is not a trivial accomplishment for children to coherently produce and comprehend make-believe stories. According to Rescher (1961, 1964), belief-contravening suppositions are integrated and reconciled with a network of accepted beliefs by temporarily retaining some accepted beliefs and rejecting others in order to create a logically consistent and complete set of beliefs with which to work. Rescher (1964) outlined one way to order possible reconciliations in terms of their consistency with already accepted beliefs and knowledge, through the application of modal logic (see Revlin, Calvillo, & Mautone, 2003; Revlin, Cate, & Rouss, 2001). However, there is no single, logical, or automatic solution to the problem of reconciliation because of the ambiguity in making a coherent and consistent network. Indeed, the resolution may require appealing to extralogical information from the social context to supplement the reconciliation process. Rescher...
(1961, p. 188) writes, “The essential fact is that belief-contravening supposition is not a rational resource of theoretical inquiry, but a dialectical device requiring an interlocutor (who may, of course, be simply ourselves).”

How children negotiate the conceptual and epistemic difficulties inherent in reconciling their accepted beliefs with suppositions about states of affairs that contravene their accepted beliefs is the central concern of a theory of belief-contravening reasoning. But the theory extends beyond accounting for pretend play or fictional narratives. Rescher (1961, 1964) notes that belief-contravening suppositions are entertained and reconciled with real-world beliefs not only when individuals are absorbed in make-believe, but also when they are engaged in various forms of hypothetical reasoning, including contingency-planning, thought experiments, belief-revisions and counterfactual reasoning. Hypothetical reasoning also involves a call for entertaining suppositions but in this case introduced by such expressions such as, “what if . . .” “let us suppose . . .,” “let us assume . . .” “for the sake of argument let’s agree” . . ., rather than, “let’s pretend;” “once upon a time,” and so on.

The present research examines whether or not children’s representation of and reasoning about make-believe and hypothetical belief-contravening suppositions are different from each other, and if so, how they differ. In order to make no a priori assumptions about the nature of their underlying cognitive processes, we define the difference between hypothetical and make-believe suppositions by the context in which an interlocutor (which may be the self) requests that they are entertained. Make-believe suppositions are entertained as an end in itself when a story is produced or comprehended, irrespective of whether it is enacted or imagined. Of course, one can learn important lessons from playing pretend or entering into a fictional narrative, but those lessons are learned by virtue of entering into a pretend or narrative world, not as an intention or goal of entering into it (Bergen, 2002; Green & Brock, 2000; Marsh, Meade, & Roediger, 2003; Prentice & Gerrig, 1999; Prentice & Gerrig, & Bailis, 1997; Rakoczy, Tomasello, & Striano, 2005). Hypothetical suppositions are entertained not as an end in itself, but in the service of better understanding the real world. An interlocutor may offer a belief-contravening supposition as part of a logical argument (e.g., Reducio ad absurdum) or as a means of comparing and contrasting features of an alternative world to the real world. For example, counterfactual thinking is useful for making real-world inferences (Amsel, Langer, & Loutzenhiser, 1991; Harris German, & Mills, 1996; Roese, 1997), altering real-world beliefs (Tal-Or, Boninger, Poran, & Gleicher, 2004), learning from mistakes (Roese, 1994), and re-evaluating or reappraising real-world situations (Amsel & Smalley, 2000; Landman, 1994). The generality of Rescher’s claim regarding reasoning with belief-contravening suppositions will be supported if the suppositions are represented and reasoned about in similar ways in these two different contexts.

1.1. Piagetian Theory: distinguishing between make-believe and hypothetical suppositions

There are three general hypotheses regarding how make-believe and hypothetical suppositions are represented and reasoned about, with each hypothesis associated with a different account of the nature and development of belief-contravening reasoning. The first hypothesis is that Rescher’s claim is flawed and there is no common underlying mechanism in the representation of or reasoning about make-believe and hypothetical suppositions. There is evidence of a fundamental difference between children’s ability to entertain belief-contravening pretend and hypothetical suppositions. Very young children readily represent and reason about belief-contravening pretend stipulations (Harris & Kavanaugh, 1993; Leslie, 1987; Lillard, 2001). For example, they have little difficulty accepting the pretend stipulation that “water in the cup has spilled” and from this stipulation infer
where on the table to “clean up” the imaginary mess (Harris & Kavanaugh, 1993). However, even older children fail to adequately represent and reason about belief-contravening hypotheses (Kuhn, Amsel, & O’Loughlin, 1988; Klaczynski, 2000) and logical premises (Hawkins, Pea, Glick, & Scribner, 1984; Scribner, 1977). For example, children had a great deal of difficulty correctly inferring that a conclusion (“Glasses are made of rubber”) followed logically from a belief-contravening supposition (“Glasses bounce when they fall”) along with the belief-consistent statement (“Everything that bounce is made of rubber”). Only 13% of syllogisms with counterfactual premises were answered correctly, compared to 94% of the syllogisms with premises that were congruent with prior beliefs. The error of responding on counterfactual syllogisms on the basis of the truth-value of the conclusion rather than its validity has been called an empirical bias (Hawkins et al., 1984) or inversion (Markovits & Vachon, 1989). In either case, the error reflects children’s failure to represent and reason on the basis of the belief-contravening suppositions in hypothetical reasoning contexts.

Theoretically, the position denying the generality of belief-contravening reasoning is based on Piaget and others who claim that the cognitive underpinnings of pretend and hypothetical reasoning are on opposite sides of the developmental spectrum. According to Piaget (1962, 1970), pretense is a subjective and idiosyncratic cognitive activity requiring only the ability to symbolize, which is acquired by toddlers in the preoperational stage. In contrast, Piaget (1970; Inhelder & Piaget, 1958) claims that hypothetical reasoning is an objective and logical ability to subordinate the actual to the possible, which requires formal operational abilities that are acquired during adolescence. From this perspective, belief-contravening pretend and hypothetical suppositions should be treated quite differently, with the latter being much harder than and unrelated to the former because the cognitive demands to process the pretend suppositions are minimal compared to hypothetical ones.

1.2. Decoupling: equating make-believe and hypothetical suppositions

Contrary to this view, Leslie (1987) claims that Piaget’s account of pretense may have oversimplified the conceptual and epistemic challenges arising from reconciling real-world beliefs with representations of make-believe states of affairs. He holds that a dedicated decoupling mechanism is part of the basic architecture of the cognitive system which allows for quarantining representations of pretend or any other counterfactual states of affairs from real-world knowledge and beliefs, precluding the former from affecting the latter (a situation he calls representational abuse). In Leslie’s (1987, 1994, 2002) account of pretense, decoupling involves re-representing or meta-representing primary representations as secondary ones which can be edited to include belief-contravening suppositions (e.g., I pretend of this banana, that it is a telephone). Other characterizations of decoupling do not imply the formation of meta-representations, but still involve quarantining representations of belief-contravening suppositions in mental structures that are isolated from but parallel to representations of actual states of affairs (Carruthers, 2002; Lillard, 2001; Nichols & Stich, 2000; Perner, 1991). For example, Lillard (2001) holds that in pretend, children form a mental representation of a twin earth which is exactly like the actual earth except for changes related to their pretend stipulations.

The decoupling account is consistent with Rescher’s claim that similar cognitive demands underlie the representation of and reasoning about belief-contravening make-believe and hypothetical suppositions. Theoretical accounts of decoupling suggest that it is dedicated to insure that not only pretend states of affairs are represented in quarantined mental structures but also those which are hypothetical (Carruthers, 2002) or possible (Nichols & Stich, 2000). Indeed, Lillard’s
(2001) twin-earth metaphor is based on Putnam’s (1975) philosophically powerful thought experiment about a hypothetical parallel world.

There is indirect evidence for the claim that the same processes underlie representing and reasoning about make-believe and hypothetical belief-contravening suppositions. A series of studies demonstrated that children can make valid deductions on counterfactual syllogism tasks simply by framing the counterfactual premise as make-believe (Dias & Harris, 1988, 1990; Markovits & Vachon, 1989; Richards & Sanderson, 1999). A variety of pragmatic devices have been used with children as young as two to treat counterfactual premises as make-believe which promoted them making valid deductions. For example, children were more likely to correctly affirm the conclusion (Does Freddy the Fish live in a tree?) as logically valid when a false premise (“Fish live in trees”) were presented as make-believe by such pragmatic devices as the intonation of the experimenter, the child’s use of visual imagery, and/or the extraterrestrial setting of the story compared to when such devices were not used (Dias & Harris, 1990). These results are widely interpreted as a consequence of placing a counterfactual premise in the context of a make-believe mode of processing which isolates real world knowledge (Dias & Harris, 1988, 1990; Markovits, 1993, 1995). This interpretation of the results is generally consistent with the claim that the same general decoupling mechanisms operate for representing and reasoning about belief-contravening hypothetical and make-believe suppositions separately from real-world beliefs and knowledge.

However, the evidence in support for decoupling remains weak. The effect of framing false premises as make-believe on children’s deductive reasoning was compared only with the effect of not framing false premises. No studies could be found which directly compare children’s deductive reasoning performance with false premises presented as make-believe or as hypothetical. The present research corrects this problem and presents children with the same syllogisms with false premises presented in either a make-believe or hypothetical context. If the decoupling account of belief-contravening reasoning is correct, then there should be minimal difference in performance between the two conditions. However, if the Piagetian account of belief-contravening reasoning is correct, then children would perform much better in the Make-Believe than the Hypothetical Condition.

The results of a series of two other studies on deductive reasoning with counterfactual premises suggest a different interpretation of effects of make-believe frames than those offered by Piagetian and decoupling theory. Leewers and Harris (2000) found that framing counterfactual premises as make-believe affected children’s deductive reasoning performance on counterfactual premises without a make-believe frame that was presented a week later. Rather than promoting a “make-believe” mode of processing, the make-believe frame, it was argued, function to clarify to participants the experimenter's intention that participants represent and reason with the counterfactual premise (Harris & Leewers, 2000). In a different line of research, Franks (1996, 1997) found that 10-year-olds and 14-year-olds who are poor readers made fewer correct deductive inferences than those who were good readers on counterfactual premises embedded in a story context. The role of reading skills was interpreted as central in children’s ability to entertain the counterfactual premise by their creation of a model of the fictional world depicted in the story.

### 1.3. Situation models: partially distinguishing make-believe and hypothetical suppositions

Both these results emphasize that the comprehension of social or literary goals in which counterfactual premises are presented is critical to the way such belief-contravening suppositions are represented and reasoned about. In the case of entertaining make-believe pretend or fictional suppositions, the goal is to enter into a pretend or fictional world. Research on story comprehension
suggests that mental models of a narrative world are constructed online to make sense of causal, spatial, temporal, protagonist, and intentional information from the text which otherwise may be described ambiguously and distributed across a number of utterances or sentences (Gerrig, 1993; Zwaan, 1999; Zwaan, Magliano, & Graesser, 1995; Zwaan & Radvansky, 1998). These mental models are called situation models and are distinguished from decoupled representation as a means of representing belief-contravening suppositions in that situation models are not quarantined from real-world representations (Gerrig, 1992; Harris, 2000; Walton, 1990). Fictional information may be compartmentalized from real-world knowledge, retaining its status as fictional but nonetheless integrated with real-world knowledge in the sense of affecting such knowledge (Green & Brock, 2000; Marsh et al., 2003; Prentice & Gerrig, 1999; Prentice et al., 1997). At the very least, the creation of narrative worlds has been shown to affect participants’ reaction times to questions posed about relevant real-world knowledge and beliefs (see reviews by Gerrig, 1993; Zwaan, 1999; Zwaan & Radvansky, 1998).

Situation Models allow readers to not only comprehend but also experience narrative worlds (Gerrig, 1993; Gerrig & Pillow, 2004; also see Walton, 1990, and Harris, 1998), including emotional reactions to belief-contravening suppositions. The emotional experience of fictional narratives does not reflect a conceptual confusion, but rather a willing participation in and an emotional appraisal of the fictional world by a temporarily altered appraisal system which takes input from the fictional—not the real—world (Gerrig, 1993; Harris, 1998; Walton, 1990). It is difficult to understand how a person could fully participate in and emotionally experience fictional worlds, if such worlds were represented in decoupled mental structures with a built-in separation between make-believe and real-world states of affairs.

It has been argued that situation models underlie the experience of make-believe suppositions in pretense in addition to fictional narratives (Gerrig, 1993; Gerrig & Pillow, 1998; Harris, 1998; Harris & Kavanaugh, 1993; Nicolopoulos, in press; Walton, 1990). Harris (1998, 2000; Harris & Kavanaugh, 1993) has been most explicit in conceptualizing pretense comprehension as akin to understanding fictional narratives. Three-year-olds can adopt the perspective of a character in a story, suggesting that they create online situation models of fictional narratives (Rall & Harris, 2000). In a similar vein, young children construct online models of pretend transformations, such as identifying where on a table to “clean up” imaginary water which was pretended to “spill” (Harris & Kavanaugh, 1993). Finally, children not only comprehend but emotionally participate in pretend worlds. Harris et al. (1991) and Johnson and Harris (1994) showed that young children avoid boxes in which they had imagined monsters, despite being certain that imaginary monsters are not real.

These findings suggest that decoupled representations may not adequately account for how belief-contravening suppositions are processed in narrative or pretend contexts. By isolating networks of real-world beliefs and knowledge from any influence of pretend or fictional suppositions, decoupled representations create a boundary which may be impervious to the effect that such suppositions can have on networks of beliefs. Situation models offer another way to create a boundary between representations of the real world and the narrative or pretend worlds, without proposing a dedicated representational mechanism with a hard and fast boundary. In Harris’ (1998, 2000; Harris & Kavanaugh, 1993) account of situational models, representations of make-believe episodes are mentally flagged (compartmentalized) but still can be linked to representations of real-world knowledge and beliefs (integrated), rather than being cut off from them in decoupled mental structures (for a discussion of compartmentalization and integration in text processing see, Potts & Peterson, 1985 and Potts, St. John, & Kirson, 1989). Once flagged but linked with prior knowledge and beliefs, the belief-contravening suppositions can be reconciled with prior
beliefs and knowledge to create a logically consistent and complete set with which to work. This feature seems applicable to the way children and adults alike treat belief-contravening make-believe suppositions, such as the predicament of a representing and reasoning about a princess in a far-away kingdom (Gerrig, 1993; Harris, 1998, 2000; Walton, 1990; Zwaan & Radvansky, 1998).

Harris’ account of flagged but integrated representations of make-believe suppositions also can account for how belief-contravening suppositions are treated in hypothetical contexts. As previously noted, the interlocutor’s goal in having belief-contravening suppositions entertained in hypothetical contexts is to better understand the real world. This would include having an influence on real-world beliefs and knowledge through the online construction of a mental model of an alternative world and the subjective experience of that world. For example, “close calls” such as almost finishing in first place (Medvec, Madey, & Gilovich, 1995) or just missing an airplane flight (Kahneman & Tversky, 1982) evoke thoughts about ways in which one could have overcome the obstacle and an emotional reaction to the fact that it had not been overcome. The thoughts about how those obstacles could have been avoided may also function as a learning experience altering attitudes, beliefs, and behavior (Amsel, Cottrell, Sullivan, & Bowden, 2005; Tal-Or, Boninger, & Gleicher, 2005; Zeelenberg, 1999). These thoughts could be conceptualized as belief-contravening suppositions which are compartmentalized by being flagged, but also integrated and reconciled with and a network of real-world knowledge and beliefs, but in a manner which additionally modifies the network. Unlike make-believe suppositions, the influence of hypothetical suppositions on real-world beliefs and attitudes was the interlocutor’s goal in having the supposition entertained in the first place.

According to situation model theory, belief-contravening make-believe and hypothetical suppositions are processed similarly in compartmentalized flagged representations which are nonetheless integrated with real-world knowledge. However, the two may not be similarly easy to represent and reason about. Make-believe suppositions are processed as an end in themselves without regard to their relation to real-world beliefs and knowledge, whereas hypothetical suppositions are processed intentionally and have an impact on real-world beliefs. In this sense the make-believe suppositions are fanciful and hypothetical suppositions are serious in their ontological significance (see Kalish, Weissman, & Bernstein, 2000, for a similar distinction). It is predicted from this theoretical orientation that although related in terms of the underlying cognitive processing for entertaining and reasoning, belief-contravening make-believe suppositions may be cognitively less demanding by virtue of having no ontological significance and so they are easier to represent and make inferences about than are hypothetical suppositions. That is, there is no additional goal to reconcile make-believe suppositions with real-world beliefs and knowledge to create a make-believe world with features that are as close as possible to the real world. In contrast, there is an additional verisimilitude goal to reconcile hypothetical suppositions with real-world beliefs and knowledge so as to create a hypothetical world with features that are as close as possible to the real-world to permit contrasts and comparisons between them. As a result reasoning about belief-contravening make-believe suppositions may be less cognitively demanding than reasoning about similar hypothetical suppositions.

In summary, three predictions based on these three different theoretical orientations can be made regarding the relations between children’s representation of and reasoning about make-believe and hypothetical suppositions. The Piagetian approach predicts that children’s performance correctly representing and reasoning about make-believe suppositions should be greater and unrelated
to their ability to perform these operations with parallel hypothetical suppositions because the
cognitive demands required to process the make-believe suppositions are minimal compared to
hypothetical ones. Decoupling theory predicts that because the same cognitive processes underlie
representing and reasoning about belief-contravening make-believe and hypothetical suppositions,
children’s correct performance representing and reasoning about both types should be at similar
levels and directly correlated. Finally, Situation Model theory also holds that correct performance
representing and reasoning about the two forms of suppositions should be directly correlated
because they both involve generally similar cognitive processes of compartmentalizing and integrating
the belief-contravening suppositions with real world beliefs and knowledge. However, the
goal of realistically reconciling hypothetical suppositions with real world beliefs and knowledge,
may make the cognitive demands to process belief-contravening hypothetical suppositions greater
compared to make-believe ones, resulting in a lower level of correct reasoning performance on
the former than on the latter.

2. Study 1

Study I assessed whether there are any differences in representing and reasoning about identical
make-believe and hypothetical belief-contravening suppositions. Entertaining and making infer-
ences about such suppositions may involve fundamentally different cognitive processes (Piagetian
Theory), an identical process of quarantining any supposition from real-world beliefs and knowl-
dge and making inferences about the latter which have no influence on the former (Decoupling
Theory), or similar processes of compartmentalizing and integrating the suppositions from real-
world knowledge, although the process for make-believe suppositions may less demanding than
that for hypothetical suppositions.

The domain for examining children’s ability to represent and reason on the basis of belief-
contravening make-believe and hypothetical suppositions is a conditional reasoning task which
presented counterfactual premises. In such tasks, participants are presented with a false major
conditional premise, a minor premise, and a conclusion which is in the form of a question, as in
(1):

(1) All dogs meow.
There is a dog.
Does the dog meow? (Correct Answer: Yes)

Participants are then asked to judge the validity of the conclusion; that is, whether it follows
logically from the premise independently of their real world belief with which it conflicts. In
argument (1), the conclusion, “yes, it meows,” follows logically, or validly from the premises
according to the rule of Modus Ponens. The conclusion of argument (2) (“no, it does not go
bow-wow”) also follows logically according to the same inference rule:

(2) All dogs meow.
There is a dog.
Does the dog bow-wow? (Correct Answer: No)

To test whether or not children’s representation of and reasoning about the pretend and hypo-
thetical worlds is different from each other, Study 1 was designed with two between-subject
conditions. The Make-Believe Condition invited children to represent false premises as suppos-
tions that they temporarily pretend to be true. The Hypothetical Condition invited children to
represent the same false premises as suppositions they temporarily believe to be true. The Pretend
Table 1
The syllogism used in each condition, Study 1

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Syllogism responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Make-Believe</td>
<td>Freddy pretends that all dogs meow. Thinking like Freddy, I pretend that all dogs meow. There is a dog. Does the dog meow? (Yes)</td>
</tr>
<tr>
<td>Hypothesize</td>
<td>Freddy pretends that all dogs meow. Thinking like Freddy, I believe that all dogs meow. There is a dog. Does the dog meow? (Yes)</td>
</tr>
<tr>
<td>Hypothetical</td>
<td>Freddy pretends that all dogs meow. Thinking like Freddy, I pretend that all dogs meow. There is a dog. Does the dog bow-bow? (No)</td>
</tr>
<tr>
<td></td>
<td>Freddy pretends that all dogs meow. Thinking like Freddy, I believe that all dogs meow. There is a dog. Does the dog bow-bow? (No)</td>
</tr>
</tbody>
</table>

and Hypothetical conditions were carefully equated as much as possible to ensure that the task requirements were similar as was the invitation to entertain the supposition. To this end, participants in Study 1 were not asked to actively pretend or hypothesize, as it was difficult to truly equate the contexts. Pragmatically, a request to fancifully engage in pretend play may be different than a request to seriously engage in hypothetical reasoning.

Rather than encouraging them to pretend or hypothesize, participants were invited to think like a protagonist, a hand puppet named Freddy who was just pretending or really believed that silly statements (e.g., dogs go meow) he utters are true. The request that participants adopt the mental state of another involves a similar invitation to represent the state of affairs referred to in the proposition.\(^1\) Imitating Freddy’s belief regarding the belief-contravening supposition is a request to seriously entertain it, as if it were true about the world and accepted in Freddy’s network of accepted beliefs. However, “just pretending” the belief-contravening supposition is a request to fancifully entertain it, as if it were a belief unrelated to Freddy’s network of accepted beliefs.

Participants in Study 1 were solicited among older elementary-school children who presumably grasped the difference between mental states of believing and pretending (Lillard, 2001; Perner, Baker, & Hutton, 1994). Each participant received a set of six syllogisms, three in which the correct response was “yes” and three in which the correct response was “no,” in either the Make-Believe or Hypothetical Condition (see Table 1).

3. Method

3.1. Participants

Fifty-two elementary-school-aged children (18 males, 34 females) whose parents completed consent forms were the participants in the study. The participants were in the 4th (\(N = 31\)) or 5th (\(N = 21\)) grade and were between 9 and 11 years old (\(M = 9.59\) years, S.D. = .69 years). Participants in each classroom were block randomly assigned to either the Make-Believe or Hypothetical Conditions.

\(^1\) We considered having participants adopt a probabilistic or implicit attitude towards the truth of the proposition (e.g., Freddy is thinking that maybe all dogs meow or Freddy is assuming that all dogs meow). However, such a request would require children to represent not only the belief-contravening supposition, but additionally a degree of belief or level of certainty with regard to those suppositions (Scholnick & Wing, 1983). Only the former requirement seemed necessary to equate the hypothetical with make-believe suppositions.
3.2. Procedure

Participants were tested individually by a male experimenter who sat with them at a desk located in a quiet area of the school. The experimenter first introduced the participant to Freddy (a hand puppet), with whom they were going to play some games. Freddy was described as someone who sometimes makes silly statements and the game involved answering questions about what Freddy says. Freddy then made the first of six “silly” statements, which functioned as the false premise of a conditional syllogism. The six statements included, “All dogs meow,” “All grass is blue,” “All water feels dry,” “All cows quack,” “All snow is black,” and “All fire feels cold.” In response to this silly statement, the experimenter turned to Freddy and, with an incredulous look and a surprised tone, asked whether Freddy had really just said what he had (repeating the statement).

Freddy acknowledged that he had made the statement and then the experimenter turned to the participant and asked the first of a series of control questions. The first control question that participants were asked was the TRUTH QUESTION, which assessed whether participants indeed judged Freddy’s claim to be false (i.e., “Is it true that all dogs go meow? Yes or No?”). After acknowledging that the premise was false, which all participants did, the experimenter looked back at Freddy and asked, “Why did you say that (all dogs go meow)”? In the Hypothetical Condition, Freddy responded with, “I really believe it. Something I really believe about (all dogs is that they go meow).” In the Make-Believe Condition, Freddy responds, “I am playing pretend. Something I am just pretending about (all dogs is that they go meow).” Participants were block randomized into either the Make-Believe or the Hypothetical Condition and received all six syllogisms in that condition.

The second control question they were posed was the PROPOSITION MEMORY QUESTION, which assessed participants’ recognition of Freddy’s original statement (i.e., “Did Freddy say that all dogs go meow, Yes or No?”). Only three participants made a mistake on this question, and each error was corrected. The MENTAL STATE MEMORY QUESTION was a check to insure that participants recalled Freddy’s mental state with regard to the false premise (e.g., “Is Freddy playing pretend or does he really believe that all dogs go meow?”). Again, the few errors that were made were corrected by the experimenter.

After recognizing Freddy’s mental state as pretending or believing the belief-contravening supposition, participants were told “I want you to think just like Freddy does. Be like Freddy and really believe/just pretend that (all dogs go meow).” The last control question was the MANIPULATION CHECK QUESTION and it was posed to insure that participants had adopted Freddy’s mental state (e.g., “Are you [just pretending/really believing] that all dogs meow? Yes or No”). Children who failed to correctly answer the Manipulation Check Questions were re-run though the procedure for the particular premise and asked the Manipulation Check Questions again. If they incorrectly answered the question again, they were coded as having failed to represent the major premise for that task (and as having given an incorrect response on the deduction question) and the procedure continued on to the next premise. A number of students had difficulty with the question on all the Manipulation Check Questions; their performance is discussed in the results section.

After acknowledging that they had adopted Freddy’s mental state of pretending or believing a belief-contravening supposition is true, participants were told to use the premise to answer the DEDUCTION QUESTION (e.g., answer the next question while pretending/believing that [all dogs meow]). The deduction question involved presenting a minor premise (e.g., Rover is a dog) and one of two versions of the conclusion. In one version of the conclusion the correct answer is
“yes” (e.g., Does Rover go meow? Yes, No, or Maybe?), in the other version, the answer is “no” (Does Rover go bow-wow? Yes, No, or Maybe?). Six syllogisms were presented to each participant. The correct answer was Yes on three syllogisms and No on the other three. The order of presentation of the syllogisms was alternated over trials and counterbalanced over participants.

4. Results

Participants’ correct responses out of three for each type of syllogism was summed and subjected to a 2 (Condition: Make-Believe versus Hypothetical) by 2 (Response: Yes versus No) by 2 (Task Order, Yes Syllogism First versus No Syllogism First) mixed-model, repeated-measure ANOVA. While mean correct judgments were higher in the Make-Believe ($M = 1.67$) than the Hypothetical ($M = 1.14$) condition, the effect was not significant, $F(1,48) = 1.98$, $p = .17$. The only significant effect was a Condition by Response by Task Order effect, $F(1,48) = 5.023$, $p < .03$ (see Fig. 1). This was due to higher rate of correct responses in the Make-Believe than the Hypothetical condition for each syllogism type in each presentation order except for “No” Syllogisms when they were presented second in an alternating sequence. We have no explanation for this pattern.

One of the difficulties with the above analysis is that the standard deviations of participants’ correct responses was high (averaging 1.41 correct responses over Conditions and Orders), due to participants’ uniform correct or incorrect performance on trials. For this reason, the data were recoded nominally, with participants being identified as “correct” (binomial $p < .05$)\(^2\) if each of the three responses to a given Syllogism Type was correct. The number of participants whose syllogism performance was consistently correct was summed and subjected to a 2 (Condition) by 2 (Response) by 2 (Task Order) mixed-model, repeated-measure ANOVA. The proportion of

\(^2\) There were three possible responses (.33) over three trials resulting in the binomial $p$ of $33^3 = .036$. 

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participants making consistently correct judgments was higher in the Make-Believe (54%) than the Hypothetical (27%) Condition, $F(1,48) = 4.34, p < .05$. In the Make-Believe Condition, the responses of 12 of the 23 participants were not consistently correct; among these, 9 consistently (5 or more) made conversion errors (i.e., inferring a true rather than a valid conclusion) and 3 were inconsistent. In the Hypothetical Condition, the responses of 19 out of the 23 participants were not consistently correct. Of the 19 who erred in the Hypothetical Condition, 8 consistently made conversion errors and 5 were inconsistent. The remaining 6 participants consistently denied that they were in the mental state of belief and so were coded as having failed to adopt the false premises. In comparison, no one in the Make-Believe Condition was so coded (binomial $p < .05$).

5. Discussion

The results suggest that reasoning with belief-contravening suppositions poses a challenge for children, particularly in the Hypothetical Condition. However, even in the Make-Believe Condition, the present study found more errors by older children than did other studies (e.g., Dias & Harris, 1988, 1990; Markovits & Vachon, 1989; Richards & Sanderson, 1999). One explanation for this is that children in the present study did not actually engage in pretense and they were not encouraged to do so. Instead, for reasons of experimental equivalence, participants were merely asked to emulate the mental state of a puppet who said it was pretending. Neither the puppet nor the experimenter engaged in activities to support participants’ adopting a pretend mental state. The syllogisms were rich in potential imagery, but no direction was given to mentally imagine the propositions. So the overall performance of participants was much lower than it might have been.

Despite being limited in its support of participants adopting a pretend attitude towards the belief-contravening supposition, the responses of a majority of participants in the Make-Believe Condition were consistently correct. This rate dropped to a quarter of the participants who responded consistently correctly in the Hypothetical Condition. The unique difficulty that the Hypothetical Condition posed to participants appears to lie in them accepting hypothetical suppositions (i.e., agreeing they were “believing”) and not reasoning consistently on their basis (i.e., making conversion errors). The number of participants who made conversion errors in each condition was approximately the same as the number who were inconsistent. However, failing the manipulation check question occurred exclusively in the Hypothetical Condition.

The tendency of a sizable minority of 10-year-olds to reject entertaining a belief-contravening stipulation is reminiscent of traditional villagers balk ing at the invitation to engage in the simplest forms of conditional reasoning with unfamiliar premises (Luria, 1976; Scribner, 1977). The villagers’ lack of knowledge about the truth of premises and the 10-year-olds’ availability of beliefs which contravene the premises was an obstacle for each group to represent the premise. Scribner (1977) explained the failure of the traditional villagers as due to their lacking an education-based abstract mode of processing. Her account was challenged by evidence, largely replicated here, that framing a belief-contravening supposition as make-believe allows for even nominally educated children to perform correctly.

There remain at least three explanations of the difference in performance in the Hypothetical and Make-Believe Conditions. First, perhaps participants’ difficulties lie in not being clear enough about why they should even temporarily accept a belief-contravening hypothetical supposition. The invitation to “believe” false premises when they conflict with other beliefs may be pragmatically less familiar, acceptable, clear, and/or appropriate than the invitation to treat the premises
as “pretend.” In such a case the difference between the two conditions may reflect the experimenter’s failure to make clear to participants that they should accept the false premise (Harris & Leevers, 2000a, 2000b). This argument is consistent with Decoupling theory, as it suggests that if the contexts in which make-believe and hypothetical beliefs-contravening suppositions are made equal in their support of individuals entertaining such suppositions, there should be no difference by condition in reasoning performance.

Second, the difference in performance may reflect a fundamental cognitive developmental difference underlying the ability to represent and reason about make-believe and hypothetical belief-contravening suppositions. This position is closest to Piaget but also finds support in Luria (1976) and Scribner (1977), although they differ on details about what is developing and how it develops. This position would be supported by evidence of the early development of reasoning about belief-contravening pretend suppositions and the independent emergence at a later time of the ability to reason about belief-contravening hypothetical suppositions.

The third position, associated with Situation Model theory, suggests that representing and reasoning about make-believe and hypothetical belief-contravening suppositions are similar but that the latter suppositions are conceptually more challenging to represent and reason about than the former, even if the pragmatics of the context are equalized. Unlike the other two positions, Situation Model theory uniquely predicts that despite being reasoned about differently, the two forms of reasoning are related.

6. Study 2

Study 2 was designed to systematically test the theories of how make-believe and hypothetical belief-contravening suppositions are represented and reasoned about. Like Study 1, Study 2 tests the theories by exploring performance on conditional syllogisms with false premises in make-believe and hypothetical contexts. Participants were confronted with belief-contravening suppositions which required that they entertain the idea that a target animal has characteristics typically associated with other animals. A total of six belief-contravening suppositions were created in that manner—dogs meow (like cats), giraffes hippity-hop (like rabbits), turkeys make webs (like spiders), cows make honey (like bees), and elephants hiss and rattle their tails (like rattle snakes).

Various design features of Study 1 were altered in Study 2 to allow for a better test of the theories of reasoning with belief-contravening suppositions. First, to allow an assessment of the developmental relation between performance reasoning about belief-contravening suppositions in make-believe and hypothetical contexts, the sample included kindergarten students, 3rd and 4th graders, and college students. Only the Piagetian account of belief-contravening suppositions proposes a developmental relation in reasoning about make-believe and hypothetical belief-contravening suppositions.

The second change from Study 1 was that a within-subject design was used to vary the presentation of belief-contravening make-believe and hypothetical suppositions. This design feature permits not only a comparison between frequency of correct performance when reasoning with the different suppositions, but also a correlation between the performances. Only the Situation Model theory proposed that although different in frequency, there should be a direct positive correlation between the performances.

The third change was that participants were more supported to represent and reason about make-believe and hypothetical suppositions. Rather than emulating mental states, participants in Study 2 were directly invited to adopt a pretend or hypothetical supposition. In the Make-Believe
Condition, participants were explicitly told to “pretend in a make-believe world . . . (e.g., dogs meow).” In the Hypothetical Condition, participants were explicitly told to “imagine what the real world would be like if . . . (dogs meow).” Additional features of the design promoted participants’ entertaining the supposition and understanding the task. Participants were invited to discuss the imagined or pretended counterfactual entity that they created (e.g., “Is there anything special or unique about the dog that you are pretending/imagining meows”). While not coded, we expected that such a question would support participants’ deeper engagement of the suppositions with which they were presented. Participants also received a practice trial when first being given the Make-Believe and Hypothetical Conditions. The practice trial offered participants feedback for their deductive inference, correcting any and all the inferential mistakes they may have made. We expected the feedback and correction would clarify the experimenters’ intention that participant’s reason on the basis of the belief-contravening suppositions. These design features were designed to engage participants to entertain suppositions and reason with them. Only the Decoupling theory proposes that under these conditions participants will perform similarly and at the same level in representing and reasoning about make-believe and hypothetical suppositions.

Other changes from Study 1 include using only “Yes” syllogisms. Performance on the “Yes” and “No” syllogisms was largely similar in Study 1 so it did not seem necessary to additionally vary the syllogism type. Participants made few “maybe” responses on the syllogisms, so responses on the syllogisms were made into forced-choice yes or no responses. An additional design feature of Study 2 was that after each syllogistic inference, participants were asked about attributes of the entity they created. Participants were asked specific questions regarding features strongly associated with the subject (dogs) and object (cats) of a belief-contravening supposition (all dogs meow). For example, participants were asked about whether the dog that meows also growls, wags its tail, purrs, and eats mice. The first two features are associated with dogs and the last two with cats.

Comparing the attributes of hypothetical and make-believe entities may make clearer the relation between these forms of reasoning. For example, because there are no required or necessary constraints that the features of a pretended entity be realistic, those who appropriately adopt pretend suppositions may arbitrarily affirm or deny Subject or Object features (i.e., a pretended meowing dog may have additional attributes of dogs or cats). Another means for selecting attributes may be adopted by those who appropriately represent hypothetical suppositions. Those adopting hypothetical suppositions may create a realistic entity, which is as close as possible to the real world, requiring the affirmation of an entity’s subject features (i.e., a hypothetical meowing dog must have all the attributes of a dog) without denying the entity’s object features which are judged to be necessary (i.e., a hypothetical meowing dog may have some other cat attributes which are seen as causally necessary). For example, dogs that meow may also purr (like cats), but they certainly wag their tails and growl (like dogs). In contrast, those who fail to adopt the hypothetical or make-believe supposition may be so empirically biased in their thinking that they equally affirm an entity’s subject features (e.g., meowing dogs have “dog” features) and deny the object features (e.g., meowing dogs do not have “cat” features).

7. Method

7.1. Participants

Forty kindergarten students (20 males and 20 females) ($M = 5.78$ years old, S.D. = .28 year), 40 3rd–4th grade students (20 males and 20 females); ($M = 9.69$ years old, S.D. = .69 years)
and 40 college students (20 males and 20 females); ($M = 22.75$ years old, S.D. = 4.12 years) were participants in the study. The children had consent forms completed for them by parents or guardians and the college students completed the consent form themselves. Five males and five females in each age group were blocked randomized into one of four groups reflecting the counterbalancing of the order of the Make-Believe and Hypothetical Conditions and the Task Sequences (reversal of the first and last set of three syllogisms).

7.2. Procedure

Participants were tested individually by a male experimenter who sat with the participants at a desk located in a quiet area of the school. The experimenter first introduced himself and told participants that they were going to play some thinking games. The experimenter expressed the first false premise (e.g., “people live in the ocean”) which served as the practice trial for both the Make-believe and Hypothetical Conditions. Participants were then asked the control Truth Question (e.g., “Is it true that people live in the ocean? Yes or No?”) and MEMORY questions (e.g., “Did I say that people live in the ocean? Yes or No?”). Incorrect responses to these questions were corrected.

Depending on whether the participant was assigned to the Make-Believe or Hypothetical Condition first, they received one of the following instructions. In the Hypothetical Condition the experimenter explained that he expressed the false propositions because he was “imagining what the real world would be like if people live in the ocean” and further explained that he was wondering “how things would be different if people lived in the ocean instead of living on the land.” The participant was then encouraged to “think like the experimenter and imagine what the real world would be like if people lived in the ocean.” In the Make-Believe Condition, the experimenter explained that he expressed the false proposition because he was “pretending that in a make-believe world people live in the ocean” and further explained that he was “just pretending that in a make-believe world people live in the ocean instead of living on the land.” The participant was then encouraged to “think like the experimenter and pretend that in a make-believe world people live in the ocean.”

The practice trial continued by the experimenter attempting to further support the participant in engaging the supposition. He asked, “Is there anything special or unique about people that you are imagining/pretending live in the ocean?” The experimenter would support but not seek to elaborate on the participants’ make-believe or hypothetical reasoning. After the discussion, participants were told, “While you are imagining/pretending that people live in the ocean, answer the following questions.” The experimenter then presented the minor premise (“Johnny is a person”) and the Deductive Question (“Does Johnny live in the ocean? Yes, No, or Maybe?”). Participants were asked to elaborate their answer by explaining why they made the inference they did. Participants who correctly answered the question and made reference to the premise, were told that they had performed correctly. Those who failed to answer correctly or failed to refer to the premises were told, “The correct answer is “yes” because, as I said, pretend/imagine all people live in the ocean and that Johnny is a person.”

The last set of practice trial questions concerned the features of belief-contravening suppositions entertained by the participants. Participants were asked two questions, one regarding features commonly associated with the subject of the premise (people living in the ocean) and one commonly associated with the object (fish). Because the same premise was used for both practice trials, two Subject feature questions were generated (Does Johnny the person eat fish food? Yes or No?; Does Johnny the person have scaly skin? Yes or No?) and two
Object feature questions (Does Johnny the person talk? Yes or No?; Does Johnny the person have hands and feet? Yes or No?). The order of questioning was counterbalanced over participants.

The experimental trials were structured similarly to the practice trials, except without the feedback or a “correct” or “incorrect” response on the syllogism task (see Appendix A). Also, each participant received two Subject and two Object feature questions after their syllogism response. Six syllogisms were presented to each participant (see Appendix A for items and the questions). The Task Order (first set of three versus second set of three) and Condition Order (Make-Believe versus Hypothetical first) in which each syllogism was presented were counterbalanced over participants. Participants were block randomized at each age group into one of four groups, with the proviso of an equal distribution of sex. Two groups received the Make-Believe Condition first and two received the Hypothetical Condition First. One of the Make-Believe- and Hypothetical-first groups received the Fish, Giraffes, and Turkeys premises first and the other group received the Dogs, Cows, and Elephants premises first.

8. Results

8.1. Practice trial performance

The results of the practice items were revealing of the difficulties participants were experiencing on the task. There was a tendency for participants to make more practice inference errors in the Make-Believe Condition when it was presented first (17/60 or 28%) than when it was presented second (8/60, 13%). Binomial \( p = .052 \) (one-tail). In contrast, there was no difference in practice inference errors in the Hypothetical Condition when it was presented first (26/60 or 43%) or second (25/60, 42%). These findings suggest that experience with and corrective feedback in the Hypothetical Condition helped participants perform better in the Make-Believe practice trial. However, the reverse did not obtain, such that participants demonstrated no effect of help on the Hypothetical practice trial from experience with and corrective feedback in the Make-Believe Condition.

8.2. Syllogism task performance

Participants’ correct responses out of three for each type of syllogism in each condition was summed and subjected to a 3 (Age Group) by 2 (Condition: Make-Believe versus Hypothetical) by 2 (Condition Order: Make-Believe first versus Hypothetical first) mixed-model, repeated-measure ANOVA. There was a main effect of Condition, with more correct responses in the Make-Believe \((M = 2.41)\) than the Hypothetical \((M = 1.99)\) condition, \(F(1,114) = 18.01, p < .001\). There was also a main Age Group effect, with fewer correct overall responses (out of 3) among Kindergarten \((M = 1.40)\) than 3rd–4th graders \((M = 2.28)\) and lower scores among the latter group than College students \((M = 2.93)\), \(F(2,114) = 40.23, p < .001\).

There was a Condition by Group interaction effect, \(F(2,114) = 3.57, p < .05\), which follow-up \(t\)-tests showed was due to each of the two children’s groups performing correctly more frequently in the Make-Believe than the Hypothetical conditions (Kindergarten \(t(39) = 4.11, p < .05\); 3rd–4th graders’ \(t(39) = 4.11, p < .05\)), but the college students performing correctly equally frequently in both conditions (College \(t(39) = 1.00, \text{n.s.}\) (see Fig. 2). Finally, there was an Age Group by Condition by Condition Order interaction effect, \(F(2,114) = 3.66, p < .05\), see Fig. 2. Follow-up 2 (Condition) by 2 (Condition Order) repeated measures ANOVAs run separately on correct
performance in each age group revealed a significant Condition by Condition Order effect only among Kindergarten children, $F(1,38) = 7.43, p < .01$ (see Fig. 2). There was a tendency among Kindergarten children to perform correctly more often on the first presented syllogism than the second (Make-Believe: first $M = 1.85$ versus second $M = 1.60$; Hypothetical: first $M = 1.35$ versus second $M = .80$). These results are related to those regarding the effect of condition order on practice trial performance and suggest the lack of independence of within-subject experimental conditions (Hawkins et al., 1987; Leevers & Harris, 2000).

Again, because of the relatively high standard deviations in the frequency of correct responses, particularly between the two groups of children, the data were recoded nominally. Participants were identified as giving consistently correct responses (binomial $p < .13$) in a given condition if each of the three syllogism responses in the condition was correct. The percentage of participants who responded consistently correctly was analyzed with a 3 (Age Group) by 2 (Condition: Make-Believe versus Hypothetical) by 2 (Condition Order: Make-Believe first versus Hypothetical first) mixed-model, repeated-measure ANOVA. The results largely replicated the findings for the previous analysis. There was a main effect of Condition, $F(1,114) = 13.28, p < .001$, with more participants responding consistently correctly in the Make-Believe (70%) than the Hypothetical (52%) condition. There was also a main effect of Age Group, $F(2,114) = 43.51, p < .001$, with fewer participants responding consistently correctly in Kindergarten (29%) than 3rd–4th grade (60%), and fewer in the latter group than the College group (94%). Finally, a Condition by Group interaction effect approached significance, $F(1,114) = 3.06, p = .051$. More Kindergarten and 3rd–4th Grade participants performed consistently correctly in the Make-Believe (Kindergarten = 40%; 3rd–4th = 70%) than Hypothetical Conditions (Kindergarten = 17%; 3rd–4th = 45%), $t(39) = 2.50–3.37, p < .05–.01$. There were no differences in the

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3 The binomial probability of three correct responses in Study 2 is higher than in Study 1 because the "maybe" response was not offered in Study 2.
percentage of consistent College students in the Make-Believe (95%) and Hypothetical (93%) conditions.

The proportion of participants who responded consistently correctly on Hypothetical and Make-Believe syllogisms was compared to chance responding (.125 correct, reflecting two response options ("yes" or "no" on each of three trials). Only Kindergarten children’s performance on Hypothetical syllogisms (17%) was at chance level, t(39) = .82, n.s., with an above-chance percentage of participants in all other conditions, t(39) = 3.51 – 23.64, p < .001 – .0001.

8.3. Relation between syllogism performances

The frequency of correct performance on the Make-Believe and Hypothetical syllogisms was correlated independently of all available demographic (age, group, gender) and design-related (syllogism order, task sequence) variables. The correlation coefficient was significant and positive, r(113) = .30, p < .05. Contingencies between consistently correct performance on Make-Believe and Hypothetical syllogisms overall and within the Kindergarten and College groups were also significant, \( \chi^2(1) = 12.74 - 25.97, p < .01 \). The contingency for 3rd–4th graders only approached significance, \( \chi^2(1) = 3.37, p = .07 \). But more importantly, the relation reflected a tendency for syllogism performance on one task to be negatively related to performance on the other exclusively for this group. Most participants (N = 26, 65%) responded consistently correctly to either the Make-Believe (N = 19) or Hypothetical (N = 7) syllogisms, leaving only a minority (N = 14, 35%) who were consistently correct on neither (N = 3) or both (N = 11) of the syllogism types. Indeed, correlations performed exclusively on these participants revealed a negative Pearson \( r \) for the frequency of correct performance on syllogism types, \( r(40) = -.26, p = .07 \), and a significant negative Spearman \( \rho \) for the relation between consistently correct performance on each syllogism type, \( \rho(30) = .31, p = .05 \). For these participants, there was an antagonism between consistent syllogism performances with the two types of belief-contravening suppositions.

8.4. Analysis of attribute judgments

Attribute judgments were coded by whether they were consistent with prior knowledge and beliefs and summed to compose an “empirical attribute score.” For example, responses affirming the presence of Subject attributes (e.g., characteristics of dogs, given the supposition that all dogs meow) and denying the presence of Object attributes (e.g., characteristics of cats, given the supposition that all dogs meow) were each scored as 1; that is, as judgments that were consistent with prior knowledge. Participants made a total of six Subject and Object judgments in each condition (two Subject and two Object attributes in each of three Hypothetical and Make-Believe trials) and could receive a total empirical attribute score of six for each feature in each condition.

Participants’ empirical attribute scores were analyzed by their performance on the syllogism tasks. Participants were categorized into one of three response groups, depending on whether they performed consistently correctly in None, the Make-Believe, or Both syllogism conditions.\(^4\)

\(^4\) There were only seven participants (all in the 3rd–4th grade who were consistently correct on Hypothetical but not the Pretend Syllogisms. The distribution of Response Groups was different in different Age Groups, \( \chi^2(4) = 75.54, p < .001 \), but was unrelated to other demographic (Gender) and design (Condition Order, Task Sequence) variables.
A 2 (Topic: Subject versus Object), by 2 (Condition: Make-Believe versus Hypothetical) by 3 (Response Group: None, Make-Believe, Both) repeated measures ANCOVA was run on the attribute judgments, with Age Group as a covariate. There was a main effect of Response Group, with those performing consistently correctly in neither condition (i.e., the None response group) having a higher overall empirical attribute score ($M = 4.63$) than those in the other conditions (Make-Believe Only: $M = 3.49$ Both: $M = 4.33$) $F(2,116) = 3.32$, $p < .05$. This reflects a greater tendency to make empirically based attribute judgments among those whose syllogism performance similarly relied on empirical knowledge.

The main Response Group effect was moderated by a Response Group by Condition interaction, $F(2,109) = 4.93$, $p < .01$ (see Fig. 3). One-way ANCOVAs by Response Group were run separately on the empirical attribute scores in the Make-Believe and Hypothetical conditions, with Age Group as a covariate. There was only a Response Group effect for empirical attribute scores in the Make-Believe Condition, $F(2,109) = 10.71$, $p < .001$. Participants who made consistently correct responses in only the Make-Believe Condition had a lower empirical attribute score ($M = 3.06$) than those who made consistently correct responses in No ($M = 4.57$) or Both ($M = 4.26$) conditions.

The empirical attribute score of participants who made consistently correct responses in only the Make-Believe Condition ($M = 3.06$) was no different than chance responding, $t(28) = 3.4$, n.s.

The empirical attribute scores of participants in other response groups in the Make-Believe and Hypothetical Conditions were each above chance, $t$'s$(28 − 55) = 3.91 − 8.17$, $p$'s $< .01 − .001$.

Finally, the analysis of the attribute responses revealed an additional Features by Response Group effect, $F(2,109) = 3.02$, $p = .05$ (see Fig. 4). Follow-up $t$-tests revealed that participants who consistently responded correctly to both Make-Believe and Hypothetical syllogisms had a higher empirical attribute score for Subject ($M = 4.94$) than Object ($M = 4.04$) features. Such a pattern of attribute judgments reflects an empirical bias differentiated for the type of attribute considered. This empirical bias is independent of whether one is entertaining a pretend or a hypothetical supposition.

Together, the attribute judgments findings suggest that participants’ performance on the syllogism task was related to the features of the entities they imagined. Participants who
made consistently correct syllogism responses in no condition (None Response Group) made
attribute judgments similarly to their syllogism judgments, reflecting a general empirical bias.
Their empirically bias in attribute judgments was indiscriminate and applied equally to Sub-
ject and Object features. The attribute judgments of participants who made correct syllogism
responses in only the Make-Believe Condition (Make-Believe only Response Group), when
asked to make believe a fictional entity were as likely to be consistent with or in violation
of their real-world knowledge about the entities. That is, they made attribute judgments about
pretended entities without being constrained by their empirical knowledge about those enti-
ties. This lack of empirically constraint in attribute judgments was indiscriminately applied
equally to Subject and Object features of the pretend entity. Finally, the attribute judgments
of those participants who made consistently correct syllogism judgments in both conditions
(Both Response Group) were significantly above chance, reflecting an empirical constraint
in their attribute judgments. For these participants, the empirical constraint was stronger for
judgments about Subject than Object features in both the Pretend and Make-Believe condi-
tions.

The upshot is that participants whose Make-believe but not Hypothetical syllogistic perfor-
mane was consistently correct characterized the pretended entity in an empirically unconstrained
manner. The unconstrained use of imagination is exemplified by one kindergarten child mentally
created Rover, who not only meows but also wags its tail, purrs and eats mice but does not
growl. However, those whose performance on Make-believe syllogisms was consistently correct
were more constrained by empirical knowledge in characterizing their pretend supposition if
they additionally performed consistently correctly on the Hypothetical syllogisms. These par-
ticipants’ pretend entities were notable for being more empirically constrained in Subject than
Object features of the premise. For example, a 3rd–4th-grade student characterized Rover the
dog who meows just like any other dog, as growling and waging its tail. However, although
the 10-year-old denied that the meowing dog eat mice, she thought it might purr, given that it
meows.
9. Discussion

Study 2 was designed to better test theories of representing and reasoning about belief-contravening suppositions. Piagetian Theory holds that representing and reasoning about belief-contravening make-believe suppositions would involve fundamentally different cognitive processes than hypothetical ones. There was some evidence in support of this position in that consistently correct performance on hypothetical suppositions generally emerged later than similar performance on make-believe suppositions. Additionally, there were developmental changes in participants’ reasoning about the supposed attributes of make-believe and hypothetical entities. Judgments about the supposed attributes of make-believe entities were made in an arbitrary manner, sometimes consistent with and sometimes in violation of empirical knowledge, by those who were consistently correct in their syllogistic reasoning with make-believe suppositions. These participants were generally younger than those who were consistently correct in their syllogistic reasoning with make-believe and hypothetical suppositions. The latter group made judgments about the supposed attributes of make-believe and hypothetical entities in a non-arbitrary manner, reflecting a preference for empirically based attributes, particularly for the subject features. The changes in how the supposed attributes of make-believe entities were reasoned about in light of the development of correct performance on hypothetical syllogisms suggests the emergence of a general and integrated skill for representing and reasoning about belief-contravening suppositions.

However, a number of findings suggest that belief-contravening make-believe and hypothetical reasoning skills are more developmentally similar than different. First, the direct positive correlations between the frequency of correct hypothetical and make-believe syllogistic reasoning suggest that the skills for both forms of reasoning are related. The correlation is consistent with the claim of a common cognitive process underlying syllogistic reasoning with make-believe and hypothetical suppositions. While similar, the 3rd–4th grade students appeared to be working out the differences between reasoning in the two conditions, such that there was a negative correlation between consistently reasoning with hypothetical and make-believe suppositions. Second, the impact of task order on syllogistic reasoning performance (i.e., the transfer effects on both the practice and experimental syllogistic reasoning tasks) suggests there is a relation between the two forms of reasoning. These data point to the fact that make-believe and hypothetical reasoning skills are not sequential, forming a developmental progression, but are related skills which may be becoming better differentiated and integrated over age.

The findings point to the similarities and also the differences between the two forms of reasoning. Such a conclusion is inconsistent not only with Piagetian but also with Decoupling theory, which suggests that the same decoupling process underlies the representation and reasoning about make-believe and hypothetical suppositions. The findings from Study 1 of a difference between performances on the two syllogism types might have been due to participants more readily understanding and complying with the request to entertain make-believe than hypothetical belief-contravening suppositions. Study 2 was designed with features to support participants understanding and complying with the request to represent and reason about both types of suppositions. Performance was generally higher in Study 2 than it was in Study 1, suggesting that some of the features functioned as expected. In particular, the feedback participants received regarding their syllogistic judgments may have improved their performance. Comparing the performance of comparably aged elementary school children participants shows that reasoning performance improved between 16 and 18% from Study 1 to Study 2 in the Make-Believe (54–70%) and Hypothetical (27–45%) conditions. These data point to the conclusion that the invitation to represent
suppositions and reason on their basis was made clearer to participants in Study 2 than it was in Study 1.

Despite the correction between performances in the two conditions, reasoning about hypothetical syllogisms was more difficult than reasoning about make-believe ones for reasons other than difficulties understanding the request to entertain them. The attribute judgment data provides clues as to why this might be. The extent to which the attribute judgments regarding belief-contravening suppositions were reconciled with real-world beliefs and knowledge was related to the syllogism performance. Given that the supposition is initially entertained, the more realistic the reconciliation of the suppositions with prior beliefs and knowledge the more sophisticated the performance. Those whose syllogistic reasoning performance was consistently correct in neither the make-believe nor the hypothetical condition were indiscriminately empirical in their judgments. These participants showed no tendency to represent or reason about belief-contravening suppositions and answered most questions (attribute and syllogism) on the basis of their prior knowledge or beliefs.

Those participants who were consistently correct in only the make-believe condition were arbitrary in their attribute judgments in that condition. These participants were unconstrained by their empirical knowledge, demonstrating little attention to or need for realistically reconciling their belief-contravening suppositions with their prior beliefs and knowledge. Instead of realistically reconciling suppositions with their knowledge and beliefs they were on flights of fancy, creating fantastic fictional worlds. There was no attempt to make the fictional world realistic although it was obviously constrained by logic, as their syllogistic performance suggests. These participants’ flight of fancy did not help them to think through the hypothetical supposition request, to “imagine what the real world would be like if . . .” That is, the unrealistic reconciliation between the make-believe supposition and real-world beliefs and knowledge in this group may have been a reason for their poor performance in the Hypothetical Condition.

Finally, participants whose syllogistic reasoning performance was consistently correct in both conditions made attribute judgments regarding both make-believe and hypothetical suppositions which were consistent with their prior beliefs and knowledge. There was more realistic reconciliation between the suppositions and prior beliefs and knowledge in this group than the others. The make-believe and hypothetical worlds they created had fewer differences with the real world in contrast to those who consistently responded correctly regarding only make-believe syllogisms.

This difference in reasoning in the latter two groups appears to reflect the purpose or goals of entertaining make-believe and hypothetical suppositions. Make-believe suppositions were described as being entertained fancifully, as an end in itself, without the goal of comparing or contrasting such suppositions to the real world. Adopting a supposition that is unconstrained by empirical knowledge is in keeping with the fanciful goal of make-believe. The creation of such a world is less cognitively demanding because of the limited extent of reconciliation with real-world knowledge that is required. In contrast, hypothetical suppositions were described as being entertained seriously, as a means to create an alternative world with features that could be compared to and contrasted with features in the real world. Adopting suppositions and expanding on their implications in a manner to make it consistent with real world would be very important to effectively and successfully reason in a hypothetical manner. However, creating an alternative world which can be compared to and contrasted with the real world would require a good deal of reconciliation with prior beliefs knowledge, making it relatively more cognitively demanding.
It is unclear why the group whose syllogistic performance was consistently correct in both conditions made attribute judgments in both the make-believe and hypothetical conditions so similarly. One explanation is that, since the group was composed largely of college students, perhaps the hypothetical mode for processing belief-contravening suppositions predominated. The child’s use of fantasy in the service of make-believe may give way to the more hypothetical uses by college students.

The results of Study 2 support the Situation Model theory’s account of representing and reasoning about belief-contravening suppositions. The theory holds that similar processes for compartmentalizing suppositions from real-world knowledge and integrating the former with the latter are central in the processing of belief-contravening suppositions. The greater difficulty involved with representing and reasoning about hypothetical than make-believe suppositions may be related to the manner by which such suppositions are reconciled with real world beliefs and knowledge. To construct realistic hypothetical suppositions, the suppositions must be made consistent with real-world knowledge and beliefs. The process of reconciling belief-contravening hypothetical suppositions with real-world beliefs and knowledge occurs despite compartmentalizing the latter from the former, through such processes as Harris and Kavanaugh’s (1993) “flagging model.” To construct fantastic make-believe worlds, the suppositions must be made distinct from real world knowledge and beliefs. That is, beyond their compartmentalization, make-believe suppositions can be further distinguished from real-world knowledge through the limited reconciliation of such suppositions with real-world knowledge. The result of this is that less reconciliation is necessary for make-believe suppositions and more is necessary for hypothetical suppositions, making the process of reasoning from the former easier than from the latter.

10. General discussion

The goal of this research was to examine the nature and development of reasoning about belief-contravening suppositions. Three theoretical positions were found to make distinct predictions about how belief-contravening suppositions are represented and reasoned about in make-believe and hypothetical contexts. In make-believe contexts belief-contravening suppositions are entertained as ends in themselves, with a goal of entering into the pretend or fictional world. In hypothetical contexts belief-contravening suppositions are entertained as a means of reasoning about the real world, with a goal of better understanding it. Reasoning about belief-contravening suppositions in these two contexts was sharply distinguished by Piaget (1962, 1970; Inhelder & Piaget, 1958) but not distinguished at all by Decoupling theory (Carruthers, 2002; Leslie, 1987; Lillard, 2001; Nichols & Stich, 2000).

The third option, developed from a review of how enacted or imagined stories are represented in situation models (Gerrig & Rupp, 2004; Harris, 1998; Harris & Kavanaugh, 1993; Zwaan & Radvansky, 1998), was that reasoning about belief-contravening suppositions in make-believe and in hypothetical contexts are distinguished but related cognitive processes. Situation Models provided a general account of how belief-contravening suppositions can be and entertained and experienced (Gerrig, 1993; Gerrig & Rupp, 2004; Harris, 1998, 2000). Indeed, it is the experience of make-believe or hypothetical worlds which cannot be accounted for in Decoupling Theory, with its assumption of a complete isolation of compartmentalized representations.

Reasoning about belief-contravening suppositions in both hypothetical and make-believe contexts is related in Situation Models by evoking similar processes for compartmentalization of
the suppositions and integration of them with prior beliefs and knowledge. But reasoning about suppositions in the two contexts is distinguished by the extent to which the suppositions are reconciled with real-world beliefs and knowledge, with the assumption that fanciful, make-believe suppositions would involve less systematic reconciliation than would serious, hypothetical ones because only the latter are purposely constructed to be realistic to allow for comparisons and contrasts with the real-world.

The results of both studies were generally supportive of the notion that situation models underlie how belief-contravening suppositions are represented and reasoned about. Syllogisms based on hypothetical suppositions were more difficult to reason about than were syllogisms based on make-believe ones, however, performance on the two forms was positively and directly correlated. This is taken as evidence that the cognitive processes underlying reasoning about make-believe and hypothetical belief-contravening suppositions are distinguished but related cognitive processes. As further evidence, the attribute judgments of those whose make-believe syllogistic performance was consistently correct were unconstrained by empirical beliefs or knowledge. This is supportive of the claim that make-believe suppositions are treated as opportunities for flights of fancy. That is not to say that the make-believe world is completely unconstrained by empirical beliefs or knowledge (cf. Harris, 2000; Harris & Kavanaugh, 1993), but only that there are limited empirical constraints in working out all the implications and consequences of accepting a belief-contravening supposition. For example, the make-believe world of a meowing dog would presumably have gravity, land, and water, but whether the meowing dog also growls and wags its tail (like a dog) or purrs and eats mice (like a cat) is up for grabs. The more a meowing dog is judged to be like a real dog and less like a real cat, the closer the make-believe word is to the real world. There was no verisimilitude goal for creating a make-believe world among those who only consistently made correct make-believe syllogistic judgments.

The goal of creating hypothetical worlds as close as possible to the real world is a central feature in hypothetical thinking about possible worlds (Lewis, 1986). One example of such a possible world is Putnam’s (1975) “twin earth,” to which Lillard (2000) appealed as a model for a decoupled pretend representation. But as we have seen, attribute judgments for make-believe suppositions may not be made with a verisimilitude goal in mind. In contrast, such a verisimilitude goal for attribute judgments was only honored by those whose performance on hypothetical syllogisms was consistently correct. Their judgments regarding the supposed attributes of hypothetical entities were constrained by empirical knowledge, particularly for subject features. Their judgment pattern keeps the subject features of the belief-contravening supposition consistent with real-world knowledge and beliefs, so that although unusual, a meowing dog has features that are consistent with most other real-world knowledge and beliefs about dogs. The empirical constraint on these participants’ attribute judgments for supposed hypothetical entities also applied to their judgments for supposed make-believe entities. As noted, it is not clear why such a pattern emerged, although the predominance of hypothetical over make-believe processing of suppositions in the lives of college students (who were mostly the ones who performed correctly in both conditions) may be one reason.

The claim that situation models underlie reasoning with belief-contravening suppositions suggests that pretend, fictional and hypothetical contexts are similar to each other as each evokes related forms of narrative processing. Narrative approaches to studying the mind are not new, highlighted most notably by Bruner’s (1986) distinction between narrative and paradigmatic (logico-scientific) modes of thought. In his discussion of a narrative mode, Bruner
(1986) emphasized its “subjunctivizing” nature, which involves use of the imagination in the service of conceiving of a world other than the world of facts. He writes (p. 26), “To be in the subjunctive mode is, then, to be trafficking in human possibilities rather than in settled certainties.” Reasoning about belief-contravening make-believe suppositions fits this quality of narrative thinking quite well. Indeed, as previously noted, situation models of understanding fiction have been theoretically applied to children’s understanding of pretense (Gerrig & Pillow, 1998; Harris, 1998, 2000; Harris & Kavanaugh, 1993; Nicolopoulou, in press).

New to this literature is the present argument that the same narrative mode of thinking underlying belief-contravening make-believe suppositions may also underlie reasoning about belief-contravening hypothetical suppositions. The narrative treatment of belief-contravening suppositions is consistent with Rescher’s (1961, 1964) notion that there is no logical or mechanical way to reconcile belief-contravening suppositions with prior beliefs and knowledge. Rescher’s (1964) interest was in explicating rules for rejecting and retaining prior knowledge and beliefs so that suppositions would be reconciled in a manner that is logically complete and consistent with prior knowledge and beliefs. Such a resolution would be necessary for the use of suppositions in the service of goals associated with Bruner’s paradigmatic mode of thinking, including inferring causes and testing hypotheses. Further research could more systematically test this central finding of the paper that distinguished but related narrative processes underlie reasoning about belief-contravening suppositions in make-believe and hypothetical contexts.

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Appendix A. Items used in Study 2

1. Fish Live in Trees

Pretend in a make-believe world that fish live in trees. Imagine what the real world would be like if fish live in trees.

While you are pretending/imagining a world in which fish live in trees, answer the following question.

Bubbles is a fish. Does Bubbles live in a tree? Yes, No

In your pretending/imagining:

- Subject 1: Does Bubbles the fish have fins? Yes, No
- Object 1: Does Bubbles the fish have wings? Yes, No
- Subject 2: Does Bubbles the fish have a tail? Yes, No
- Object 2: Does Bubbles the fish have feathers? Yes, No

2. Giraffes hippy-hop

Pretend in a make-believe world that giraffes hippy-hop. Imagine what the real world would be like if giraffes hippy-hop.

While you are pretending/imagining a world in which giraffes hippy-hop, answer the following question.

Tallie is a giraffe. Does Tallie hippy-hop? Yes, No

In your pretending/imagining:

- Subject 1: Does Tallie the giraffe have a long neck? Yes, No
- Object 1: Does Tallie the giraffe have a fuzzy tail? Yes, No
- Subject 2: Does Tallie the giraffe have long legs? Yes, No
- Object 2: Does Tallie the giraffe have big front teeth? Yes, No
3. Turkeys make webs

Pretend in a make-believe world that turkeys make webs. Imagine what the real world would be like if turkeys make webs.

While you are pretending/imagining a world in which turkeys make webs, answer the following question.

Tom is a turkey. Does Tom make webs? Yes, No

In your pretending/imagining:

Subject 1: Does Tom the turkey make gobble sounds? Yes, No

Object 1: Does Tom the turkey have eight legs? Yes, No

Subject 2: Would we eat Tom the turkey at Thanksgiving? Yes, No

Object 2: Does Tom the turkey eat flies? Yes, No

4. Dogs meowed

Pretend in a make-believe world that dogs meow. Imagine what the real world would be like if dogs meow.

While you are pretending/imagining a world in which dogs meow, answer the following question.

Rover is a dog. Does Rover meow? Yes, No

In your pretending/imagining:

Subject 1: Does Rover the dog growl? Yes, No

Object 1: Does Rover the dog purr? Yes, No

Subject 2: Does Rover the dog wag its tail? Yes, No

Object 2: Does Rover the dog eat mice? Yes, No
5. Cows make honey

Pretend in a make-believe world that cows make honey. Imagine what the real world would be like if cows make honey.

While you are pretending/imagining a world in which cows make honey,

answer the following question

Else is a cow. Does Else make honey? Yes, No

In your pretending/imagining:

Subject 1: Does Else the cow go moo? Yes, No

Object 1: Does Else the cow go buzzing around? Yes, No

Subject 2: Does Else the cow make milk? Yes, No

Object 2: Does Else the cow have stingers? Yes, No

6. Elephants hiss & rattle their tails

Pretend in a make-believe world that elephants hiss & rattle their tails. Imagine what the real world would be like if elephants hiss & rattle their tails.

While you are pretending/imagining a world in which elephants hiss & rattle their tails,

answer the following question.

Jumbo is an elephant. Does Jumbo hiss & rattle his tail? Yes, No

In your pretending/imagining:

Subject 1: Does Jumbo the elephant have floppy ears? Yes, No

Object 1: Does Jumbo the elephant have a poison bite? Yes, No

Subject 2: Does Jumbo the elephant have a trunk? Yes, No

Object 2: Does Jumbo the elephant slither on the ground? Yes, No
References


