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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 of 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; Bouchier & 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 extra-logical information from the social context to supplement the reconciliation process. Rescher

76 (1961, p. 188) writes, “The essential fact is that belief-contravening supposition is not a rational
77 resource of theoretical inquiry, but a dialectical device requiring an interlocutor (who may, of
78 course, be simply ourselves).”

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

90 The present research examines whether or not children’s representation of and reasoning about
91 make-believe and hypothetical belief-contravening suppositions are different from each other,
92 and if so, how they differ. In order to make no a priori assumptions about the nature of their
93 underlying cognitive processes, we define the difference between hypothetical and make-believe
94 suppositions by the context in which an interlocutor (which may be the self) requests that they are
95 entertained. Make-believe suppositions are entertained as an end in itself when a story is produced
96 or comprehended, irrespective of whether it is enacted or imagined. Of course, one can learn
97 important lessons from playing pretend or entering into a fictional narrative, but those lessons are
98 learned by virtue of entering into a pretend or narrative world, not as an intention or goal of entering
99 into it (Bergen, 2002; Green & Brock, 2000; Marsh, Meade, & Roediger, 2003; Prentice & Gerrig,
100 1999; Prentice & Gerrig, & Bailis, 1997; Rakoczy, Tomasello, & Striano, 2005). Hypothetical
101 suppositions are entertained not as an end in itself, but in the service of better understanding the real
102 world. An interlocutor may offer a belief-contravening supposition as part of a logical argument
103 (e.g., *Reductio ad absurdum*) or as a means of comparing and contrasting features of an alternative
104 world to the real world. For example, counterfactual thinking is useful for making real-world
105 inferences (Amsel, Langer, & Loutzenhiser, 1991; Harris German, & Mills, 1996; Roese, 1997),
106 altering real-world beliefs (Tal-Or, Boninger, Poran, & Gleicher, 2004), learning from mistakes
107 (Roese, 1994), and re-evaluating or reappraising real-world situations (Amsel & Smalley, 2000;
108 Landman, 1994). The generality of Rescher’s claim regarding reasoning with belief-contravening
109 suppositions will be supported if the suppositions are represented and reasoned about in similar
110 ways in these two different contexts.

111 *1.1. Piagetian Theory: distinguishing between make-believe and hypothetical suppositions*

112 There are three general hypotheses regarding how make-believe and hypothetical suppositions
113 are represented and reasoned about, with each hypothesis associated with a different account of the
114 nature and development of belief-contravening reasoning. The first hypothesis is that Rescher’s
115 claim is flawed and there is no common underlying mechanism in the representation of or reasoning
116 about make-believe and hypothetical suppositions. There is evidence of a fundamental difference
117 between children’s ability to entertain belief-contravening pretend and hypothetical suppositions.
118 Very young children readily represent and reason about belief-contravening pretend stipulations
119 (Harris & Kavanaugh, 1993; Leslie, 1987; Lillard, 2001). For example, they have little difficulty
120 accepting the pretend stipulation that “water in the cup has spilled” and from this stipulation infer

121 where on the table to “clean up” the imaginary mess (Harris & Kavanaugh, 1993). However,
122 even older children fail to adequately represent and reason about belief-contravening hypothe-
123 ses (Kuhn, Amsel, & O’Loughlin, 1988; Klaczynski, 2000) and logical premises (Hawkins, Pea,
124 Glick, & Scribner, 1984; Scribner, 1977). For example, children had a great deal of difficulty
125 correctly inferring that a conclusion (“Glasses are made of rubber”) followed logically from a
126 belief-contravening supposition (“Glasses bounce when they fall”) along with the belief-consistent
127 statement (“Everything that bounces is made of rubber”). Only 13% of syllogisms with counter-
128 factual premises were answered correctly, compared to 94% of the syllogisms with premises that
129 were congruent with prior beliefs. The error of responding on counterfactual syllogisms on the
130 basis of the truth-value of the conclusion rather than its validity has been called an empirical bias
131 (Hawkins et al., 1984) or inversion (Markovits & Vachon, 1989). In either case, the error reflects
132 children’s failure to represent and reason on the basis of the belief-contravening suppositions in
133 hypothetical reasoning contexts.

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

145 1.2. *Decoupling: equating make-believe and hypothetical suppositions*

146 Contrary to this view, Leslie (1987) claims that Piaget’s account of pretense may have oversim-
147 plified the conceptual and epistemic challenges arising from reconciling real-world beliefs with
148 representations of make-believe states of affairs. He holds that a dedicated decoupling mech-
149 anism is part of the basic architecture of the cognitive system which allows for quarantining
150 representations of pretend or any other counterfactual states of affairs from real-world knowledge
151 and beliefs, precluding the former from affecting the latter (a situation he calls representational
152 abuse). In Leslie’s (1987, 1994, 2002) account of pretense, decoupling involves re-representing
153 or meta-representing primary representations as secondary ones which can be edited to include
154 belief-contravening suppositions (e.g., I pretend of this banana, that it is a telephone). Other char-
155 acterizations of decoupling do not imply the formation of meta-representations, but still involve
156 quarantining representations of belief-contravening suppositions in mental structures that are iso-
157 lated from but parallel to representations of actual states of affairs (Carruthers, 2002; Lillard,
158 2001; Nichols & Stich, 2000; Perner, 1991). For example, Lillard (2001) holds that in pretense,
159 children form a mental representation of a twin earth which is exactly like the actual earth except
160 for changes related to their pretend stipulations.

161 The decoupling account is consistent with Rescher’s claim that similar cognitive demands
162 underlie the representation of and reasoning about belief-contravening make-believe and hypo-
163 theoretical suppositions. Theoretical accounts of decoupling suggest that it is dedicated to insure that
164 not only pretend states of affairs are represented in quarantined mental structures but also those
165 which are hypothetical (Carruthers, 2002) or possible (Nichols & Stich, 2000). Indeed, Lillard’s

166 (2001) twin-earth metaphor is based on Putnam's (1975) philosophically powerful thought exper-
167 iment about a hypothetical parallel world.

168 There is indirect evidence for the claim that the same processes underlie representing and rea-
169 soning about make-believe and hypothetical belief-contravening suppositions. A series of studies
170 demonstrated that children can make valid deductions on counterfactual syllogism tasks simply
171 by framing the counterfactual premise as make-believe (Dias & Harris, 1988, 1990; Markovits
172 & Vachon, 1989; Richards & Sanderson, 1999). A variety of pragmatic devices have been used
173 with children as young as two to treat counterfactual premises as make-believe which promoted
174 them making valid deductions. For example, children were more likely to correctly affirm the
175 conclusion ("Does Freddy the Fish live in a tree?") as logically valid when a false premise ("Fish
176 live in trees") were presented as make-believe by such pragmatic devices as the intonation of
177 the experimenter, the child's use of visual imagery, and/or the extraterrestrial setting of the story
178 compared to when such devices were not used (Dias & Harris, 1990). These results are widely
179 interpreted as a consequence of placing a counterfactual premise in the context of a make-believe
180 mode of processing which isolates real world knowledge (Dias & Harris, 1988, 1990; Markovits,
181 1993, 1995). This interpretation of the results is generally consistent with the claim that the same
182 general decoupling mechanisms operate for representing and reasoning about belief-contravening
183 hypothetical and make-believe suppositions separately from real-world beliefs and knowledge.

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

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

206 1.3. *Situation models: partially distinguishing make-believe and hypothetical suppositions*

207 Both these results emphasize that the comprehension of social or literary goals in which
208 counterfactual premises are presented is critical to the way such belief-contravening suppositions
209 are represented and reasoned about. In the case of entertaining make-believe pretend or fictional
210 suppositions, the goal is to enter into a pretend or fictional world. Research on story comprehension

111 suggests that mental models of a narrative world are constructed online to make sense of causal,
112 spatial, temporal, protagonist, and intentional information from the text which otherwise may be
113 described ambiguously and distributed across a number of utterances or sentences (Gerrig, 1993;
114 Zwaan, 1999; Zwaan, Magliano, & Graesser, 1995; Zwaan & Radvansky, 1998). These mental
115 models are called situation models and are distinguished from decoupled representation as a means
116 of representing belief-contravening suppositions in that situation models are not quarantined from
117 real-world representations (Gerrig, 1992; Harris, 2000; Walton, 1990). Fictional information may
118 be compartmentalized from real-world knowledge, retaining its status as fictional but nonetheless
119 integrated with real-world knowledge in the sense of affecting such knowledge (Green & Brock,
120 2000; Marsh et al., 2003; Prentice & Gerrig, 1999; Prentice et al., 1997). At the very least, the
121 creation of narrative worlds has been shown to affect participants' reaction times to questions
122 posed about relevant real-world knowledge and beliefs (see reviews by Gerrig, 1993; Zwaan,
123 1999; Zwaan & Radvansky, 1998).

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

133 It has been argued that situation models underlie the experience of make-believe suppositions
134 in pretense in addition to fictional narratives (Gerrig, 1993; Gerrig & Pillow, 1998; Harris, 1998;
135 Harris & Kavanaugh, 1993; Nicolopoulou, in press; Walton, 1990). Harris (1998, 2000; Harris
136 & Kavanaugh, 1993) has been most explicit in conceptualizing pretense comprehension as akin
137 to understanding fictional narratives. Three-year-olds can adopt the perspective of a character in
138 a story, suggesting that they create online situation models of fictional narratives (Rall & Harris,
139 2000). In a similar vein, young children construct online models of pretend transformations, such
140 as identifying where on a table to “clean up” imaginary water which was pretended to “spill”
141 (Harris & Kavanaugh, 1993). Finally, children not only comprehend but emotionally participate
142 in pretend worlds. Harris et al. (1991) and Johnson and Harris (1994) showed that young children
143 avoid boxes in which they had imagined monsters, despite being certain that imaginary monsters
144 are not real.

145 These findings suggest that decoupled representations may not adequately account for how
146 belief-contravening suppositions are processed in narrative or pretend contexts. By isolating net-
147 works of real-world beliefs and knowledge from any influence of pretend or fictional suppositions,
148 decoupled representations create a boundary which may be impervious to the effect that such sup-
149 positions can have on networks of beliefs. Situation models offer another way to create a boundary
150 between representations of the real world and the narrative or pretend worlds, without propos-
151 ing a dedicated representational mechanism with a hard and fast boundary. In Harris' (1998,
152 2000; Harris & Kavanaugh, 1993) account of situational models, representations of make-believe
153 episodes are mentally flagged (compartmentalized) but still can be linked to representations of
154 real-world knowledge and beliefs (integrated), rather than being cut off from them in decoupled
155 mental structures (for a discussion of compartmentalization and integration in text processing
156 see, Potts & Peterson, 1985 and Potts, St. John, & Kirson, 1989). Once flagged but linked with
157 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

305 to their ability to perform these operations with parallel hypothetical suppositions because the
 306 cognitive demands required to process the make-believe suppositions are minimal compared to
 307 hypothetical ones. Decoupling theory predicts that because the same cognitive processes underlie
 308 representing and reasoning about belief-contravening make-believe and hypothetical suppositions,
 309 children's correct performance representing and reasoning about both types should be at similar
 310 levels and directly correlated. Finally, Situation Model theory also holds that correct performance
 311 representing and reasoning about the two forms of suppositions should be directly correlated
 312 because they both involve generally similar cognitive processes of compartmentalizing and inte-
 313 grating the belief-contravening suppositions with real world beliefs and knowledge. However, the
 314 goal of realistically reconciling hypothetical suppositions with real world beliefs and knowledge,
 315 may make the cognitive demands to process belief-contravening hypothetical suppositions greater
 316 compared to make-believe ones, resulting in a lower level of correct reasoning performance on
 317 the former than on the latter.

318 2. Study 1

319 Study 1 assessed whether there are any differences in representing and reasoning about identical
 320 make-believe and hypothetical belief-contravening suppositions. Entertaining and making infer-
 321 ences about such suppositions may involve fundamentally different cognitive processes (Piagetian
 322 Theory), an identical process of quarantining any supposition from real-world beliefs and knowl-
 323 edge and making inferences about the latter which have no influence on the former (Decoupling
 324 Theory), or similar processes of compartmentalizing and integrating the suppositions from real-
 325 world knowledge, although the process for make-believe suppositions may less demanding than
 326 that for hypothetical suppositions.

327 The domain for examining children's ability to represent and reason on the basis of belief-
 328 contravening make-believe and hypothetical suppositions is a conditional reasoning task which
 329 presented counterfactual premises. In such tasks, participants are presented with a false major
 330 conditional premise, a minor premise, and a conclusion which is in the form of a question, as in
 331 (1):

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

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

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

340 To test whether or not children's representation of and reasoning about the pretend and hypo-
 341 theoretical worlds is different from each other, Study 1 was designed with two between-subject
 342 conditions. The Make-Believe Condition invited children to represent false premises as suppo-
 343 sitions that they temporarily pretend to be true. The Hypothetical Condition invited children to
 344 represent the same false premises as suppositions they temporarily believe to be true. The Pretend
 345

Table 1
The syllogism used in each condition, Study 1

Conditions	Syllogism responses	
	Yes	No
Make-Believe	Freddy pretends that all dogs meow. Thinking like Freddy, I pretend that all dogs meow. There is a dog. Does the dog meow? (Yes)	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)
Hypothesize	Freddy believes that all dogs meow. Thinking like Freddy, I believe that all dogs meow. There is a dog. Does the dog meow? (Yes)	Freddy believes that all dogs meow. Thinking like Freddy, I believe that all dogs meow. There is a dog. Does the dog bow-bow? (No)

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.

372 3.2. Procedure

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

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

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

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

413 After acknowledging that they had adopted Freddy’s mental state of pretending or believing
414 a belief-contravening supposition is true, participants were told to use the premise to answer the
415 DEDUCTION QUESTION (e.g., answer the next question while pretending/believing that [all
416 dogs meow]). The deduction question involved presenting a minor premise (e.g., Rover is a dog)
417 and one of two versions of the conclusion. In one version of the conclusion the correct answer is

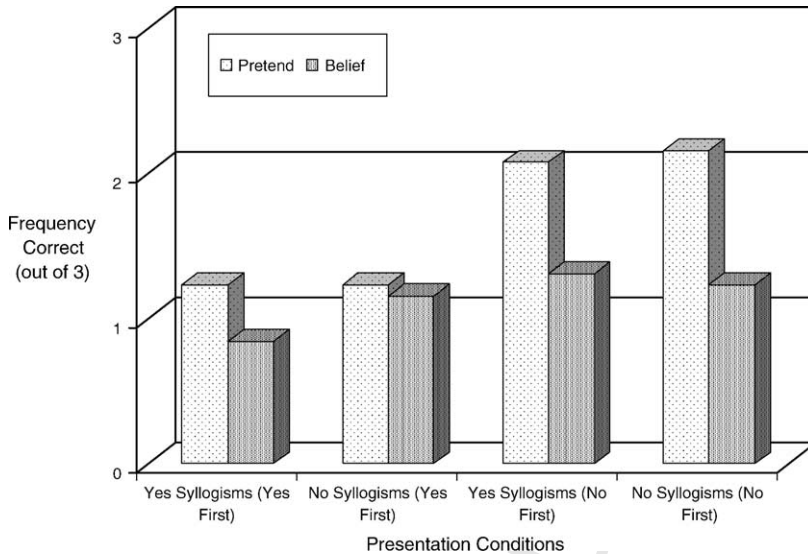


Fig. 1. Frequency of correct responses by condition and syllogism type and syllogism order, Study 1.

418 “yes” (e.g., Does Rover go meow? Yes, No, or Maybe?), in the other version, the answer is “no”
 419 (Does Rover go bow-wow? Yes, No, or Maybe?).

420 Six syllogisms were presented to each participant. The correct answer was Yes on three syllo-
 421 gisms and No on the other three. The order of presentation of the syllogisms was alternated over
 422 trials and counterbalanced over participants.

423 4. Results

424 Participants’ correct responses out of three for each type of syllogism was summed and sub-
 425 jected to a 2 (Condition: Make-Believe versus Hypothetical) by 2 (Response: Yes versus No) by
 426 2 (Task Order, Yes Syllogism First versus No Syllogism First) mixed-model, repeated-measure
 427 ANOVA. While mean correct judgments were higher in the Make-Believe ($M = 1.67$) than the
 428 Hypothetical ($M = 1.14$) condition, the effect was not significant, $F(1,48) = 1.98, p = .17$. The only
 429 significant effect was a Condition by Response by Task Order effect, $F(1,48) = 5.023, p < .03$ (see
 430 Fig. 1). This was due to higher rate of correct responses in the Make-Believe than the Hypothetical
 431 condition for each syllogism type in each presentation order except for “No” Syllogisms when
 432 they were presented second in an alternating sequence. We have no explanation for this pattern.

433 One of the difficulties with the above analysis is that the standard deviations of participants’
 434 correct responses was high (averaging 1.41 correct responses over Conditions and Orders), due
 435 to participants’ uniform correct or incorrect performance on trials. For this reason, the data were
 436 recoded nominally, with participants being identified as “correct” (binomial $p < .05$)² if each of
 437 the three responses to a given Syllogism Type was correct. The number of participants whose
 438 syllogism performance was consistently correct was summed and subjected to a 2 (Condition)
 439 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 $.33^3 = .036$.

440 participants making consistently correct judgments was higher in the Make-Believe (54%) than
441 the Hypothetical (27%) Condition, $F(1,48) = 4.34$, $p < .05$. In the Make-Believe Condition, the
442 responses of 12 of the 23 participants were *not* consistently correct; among these, 9 consistently
443 (5 or more) made conversion errors (i.e., inferring a true rather than a valid conclusion) and 3
444 were inconsistent. In the Hypothetical Condition, the responses of 19 out of the 23 participants
445 were not consistently correct. Of the 19 who erred in the Hypothetical Condition, 8 consistently
446 made conversion errors and 5 were inconsistent. The remaining 6 participants consistently denied
447 that they were in the mental state of belief and so were coded as having failed to adopt the
448 false premises. In comparison, no one in the Make-Believe Condition was so coded (binomial
449 $p < .05$).

450 5. Discussion

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

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

471 The tendency of a sizable minority of 10-year-olds to reject entertaining a belief-contravening
472 stipulation is reminiscent of traditional villagers balking at the invitation to engage in the simplest
473 forms of conditional reasoning with unfamiliar premises ([Luria, 1976](#); [Scribner, 1977](#)). The vil-
474 lagers' lack of knowledge about the truth of premises and the 10-year-olds' availability of beliefs
475 which contravene the premises was an obstacle for each group to represent the premise. [Scribner
476 \(1977\)](#) explained the failure of the traditional villagers as due to their lacking an education-based
477 abstract mode of processing. Her account was challenged by evidence, largely replicated here, that
478 framing a belief-contravening supposition as make-believe allows for even nominally educated
479 children to perform correctly.

480 There remain at least three explanations of the difference in performance in the Hypothetical
481 and Make-Believe Conditions. First, perhaps participants' difficulties lie in not being clear enough
482 about why they should even temporarily accept a belief-contravening hypothetical supposition.
483 The invitation to "believe" false premises when they conflict with other beliefs may be pragmat-
484 ically less familiar, acceptable, clear, and/or appropriate than the invitation to treat the premises

485 as “pretend.” In such a case the difference between the two conditions may reflect the experi-
486 menter’s failure to make clear to participants that they should accept the false premise (Harris &
487 Leevers, 2000a, 2000b). This argument is consistent with Decoupling theory, as it suggests that if
488 the contexts in which make-believe and hypothetical beliefs-contravening suppositions are made
489 equal in their support of individuals entertaining such suppositions, there should be no difference
490 by condition in reasoning performance.

491 Second, the difference in performance may reflect a fundamental cognitive developmental
492 difference underlying the ability to represent and reason about make-believe and hypothetical
493 belief-contravening suppositions. This position is closest to Piaget but also finds support in Luria
494 (1976) and Scribner (1977), although they differ on details about what is developing and how it
495 develops. This position would be supported by evidence of the early development of reasoning
496 about belief-contravening pretend suppositions and the independent emergence at a later time of
497 the ability to reason about belief-contravening hypothetical suppositions.

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

504 6. Study 2

505 Study 2 was designed to systematically test the theories of how make-believe and hypothet-
506 ical belief-contravening suppositions are represented and reasoned about. Like Study 1, Study
507 2 tests the theories by exploring performance on conditional syllogisms with false premises in
508 make-believe and hypothetical contexts. Participants were confronted with belief-contravening
509 suppositions which required that they entertain the idea that a target animal has characteristics
510 typically associated with other animals. A total of six belief-contravening suppositions were cre-
511 ated in that manner—dogs meow (like cats), giraffes hippity-hop (like rabbits), turkeys make
512 webs (like spiders), cows make honey (like bees), and elephants hiss and rattle their tails (like
513 rattle snakes).

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

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

527 The third change was that participants were more supported to represent and reason about
528 make-believe and hypothetical suppositions. Rather than emulating mental states, participants in
529 Study 2 were directly invited to adopt a pretend or hypothetical supposition. In the Make-Believe

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

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

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

570 7. Method

571 7.1. Participants

572 Forty kindergarten students (20 males and 20 females) ($M = 5.78$ years old, $S.D. = .28$ year),
573 40 3rd–4th grade students (20 males and 20 females); ($M = 9.69$ years old, $S.D. = .69$ years)

574 and 40 college students (20 males and 20 females); ($M = 22.75$ years old, $S.D. = 4.12$ years)
575 were participants in the study. The children had consent forms completed for them by parents
576 or guardians and the college students completed the consent form themselves. Five males and
577 five females in each age group were blocked randomized into one of four groups reflecting the
578 counterbalancing of the order of the Make-Believe and Hypothetical Conditions and the Task
579 Sequences (reversal of the first and last set of three syllogisms).

580 7.2. Procedure

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

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

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

613 The last set of practice trial questions concerned the features of belief-contravening sup-
614 positions entertained by the participants. Participants were asked two questions, one regarding
615 features commonly associated with the subject of the premise (*people* living in the ocean)
616 and one commonly associated with the object (*fish*). Because the same premise was used for
617 both practice trials, two Subject feature questions were generated (Does Johnny the person
618 eat fish food? Yes or No?; Does Johnny the person have scaly skin? Yes or No?) and two

619 Object feature questions (Does Johnny the person talk? Yes or No?; Does Johnny the per-
620 son have hands and feet? Yes or No?). The order of questioning was counterbalanced over
621 participants.

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

633 8. Results

634 8.1. Practice trial performance

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

645 8.2. Syllogism task performance

646 Participants' correct responses out of three for each type of syllogism in each condition was
647 summed and subjected to a 3 (Age Group) by 2 (Condition: Make-Believe versus Hypothetical) by
648 2 (Condition Order: Make-Believe first versus Hypothetical first) mixed-model, repeated-measure
649 ANOVA. There was a main effect of Condition, with more correct responses in the Make-Believe
650 ($M = 2.41$) than the Hypothetical ($M = 1.99$) condition, $F(1,114) = 18.01, p < .001$. There was also
651 a main Age Group effect, with fewer correct overall responses (out of 3) among Kindergarten
652 ($M = 1.40$) than 3rd–4th graders ($M = 2.28$) and lower scores among the latter group than College
653 students ($M = 2.93$), $F(2,114) = 40.23, p < .001$.

654 There was a Condition by Group interaction effect, $F(2,114) = 3.57, p < .05$, which follow-up
655 t -tests showed was due to each of the two children's groups performing correctly more frequently
656 in the Make-Believe than the Hypothetical conditions (Kindergarten $t(39) = 4.11, p < .05$; 3rd–4th
657 graders' $t(39) = 4.11, p < .05$), but the college students performing correctly equally frequently
658 in both conditions (College $t(39) = 1.00, n.s.$) (see Fig. 2). Finally, there was an Age Group by
659 Condition by Condition Order interaction effect, $F(2,114) = 3.66, p < .05$, see Fig. 2. Follow-up
660 2 (Condition) by 2 (Condition Order) repeated measures ANOVAs run separately on correct

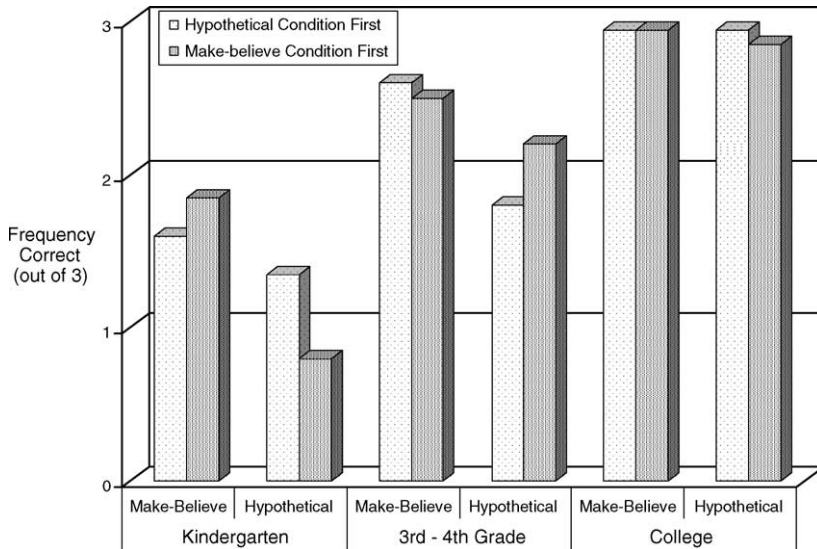


Fig. 2. Frequency of correct responses by condition, age group and condition order, Study 2.

661 performance in each age group revealed a significant Condition by Condition Order effect only
 662 among Kindergarten children, $F(1,38) = 7.43, p < .01$ (see Fig. 2). There was a tendency among
 663 Kindergarten children to perform correctly more often on the first presented syllogism than the
 664 second (Make-Believe: first $M = 1.85$ versus second $M = 1.60$; Hypothetical: first $M = 1.35$ versus
 665 second $M = .80$). These results are related to those regarding the effect of condition order on
 666 practice trial performance and suggest the lack of independence of within-subject experimental
 667 conditions (Hawkins et al., 1987; Leavers & Harris, 2000).

668 Again, because of the relatively high standard deviations in the frequency of correct responses,
 669 particularly between the two groups of children, the data were recoded nominally. Partici-
 670 pants were identified as giving consistently correct responses (binomial $p < .13$)³ in a given
 671 condition if each of the three syllogism responses in the condition was correct. The per-
 672 centage of participants who responded consistently correctly was analyzed with a 3 (Age
 673 Group) by 2 (Condition: Make-Believe versus Hypothetical) by 2 (Condition Order: Make-
 674 Believe first versus Hypothetical first) mixed-model, repeated-measure ANOVA. The results
 675 largely replicated the findings for the previous analysis. There was a main effect of Condition,
 676 $F(1,114) = 13.28, p < .001$, with more participants responding consistently correctly in the Make-
 677 Believe (70%) than the Hypothetical (52%) condition. There was also a main effect of Age Group,
 678 $F(2,114) = 43.51, p < .001$, with fewer participants responding consistently correctly in Kinder-
 679 garden (29%) than 3rd–4th grade (60%), and fewer in the latter group than the College group
 680 (94%). Finally, a Condition by Group interaction effect approached significance, $F(1,114) = 3.06,$
 681 $p = .051$. More Kindergarten and 3rd–4th Grade participants performed consistently correctly in
 682 the Make-Believe (Kindergarten = 40%; 3rd–4th = 70%) than Hypothetical Conditions (Kinder-
 683 garden = 17%; 3rd–4th = 45%), $t(39) = 2.50\text{--}3.37, p < .05\text{--}.01$. There were no differences in the

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 ρ 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 no 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.

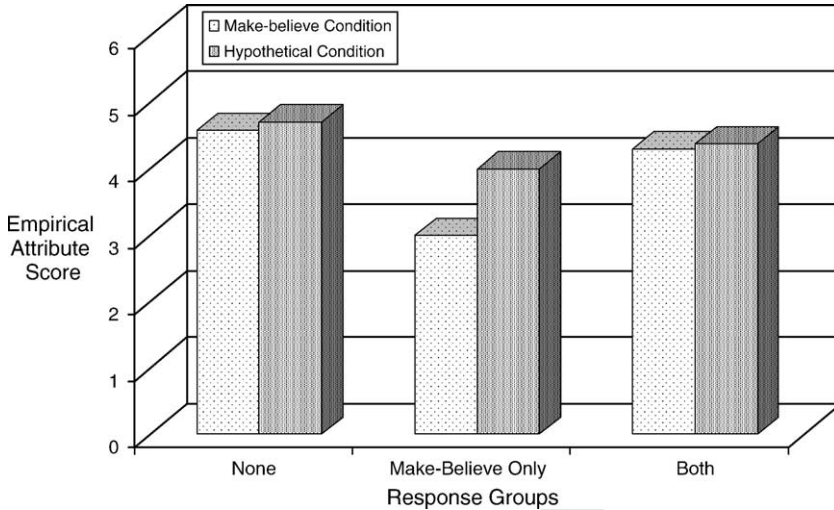


Fig. 3. Empirical attribute score (yes to Subject and no to Object Features) by Condition and Response Group.

722 A 2 (Topic: Subject versus Object), by 2 (Condition: Make-Believe versus Hypothetical) by
 723 3 (Response Group: None, Make-Believe, Both) repeated measures ANCOVA was run on the
 724 attribute judgments, with Age Group as a covariate. There was a main effect of Response Group,
 725 with those performing consistently correctly in neither condition (i.e., the None response group)
 726 having a higher overall empirical attribute score ($M = 4.63$) than those in the other conditions
 727 (Make-Believe Only: $M = 3.49$ Both: $M = 4.33$) $F(2,116) = 3.32, p < .05$. This reflects a greater
 728 tendency to make empirically based attribute judgments among those whose syllogism perform-
 729 ance similarly relied on empirical knowledge.

730 The main Response Group effect was moderated by a Response Group by Condition interaction,
 731 $F(2,109) = 4.93, p < .01$ (see Fig. 3). One-way ANCOVAs by Response Group were run separately
 732 on the empirical attribute scores in the Make-Believe and Hypothetical conditions, with Age
 733 Group as a covariate. There was only a Response Group effect for empirical attribute scores in the
 734 Make-Believe Condition, $F(2,109) = 10.71, p < .001$. Participants who made consistently correct
 735 responses in only the Make-Believe Condition had a lower empirical attribute score ($M = 3.06$) than
 736 those who made consistently correct responses in No ($M = 4.57$) or Both ($M = 4.26$) conditions.
 737 The empirical attribute score of participants who made consistently correct responses in only
 738 the Make-Believe Condition ($M = 3.06$) was no different than chance responding, $t(28) = 34, n.s.$
 739 The empirical attribute scores of participants in other response groups in the Make-Believe and
 740 Hypothetical Conditions were each above chance, t 's($28 - 55$) = $3.91 - 8.17, p$'s $< .01 - .001$.

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

748 Together, the attribute judgments findings suggest that participants' performance on the
 749 syllogism task was related to the features of the entities they imagined. Participants who

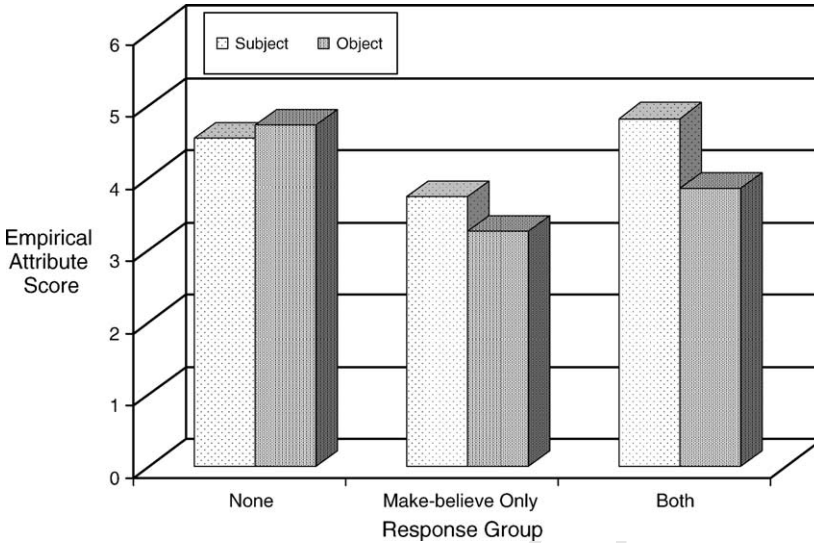


Fig. 4. Empirical attribute score (yes to Subject and no to Object features) by Feature and Response Group.

750 made consistently correct syllogism responses in no condition (None Response Group) made
 751 attribute judgments similarly to their syllogism judgments, reflecting a general empirical bias.
 752 Their empirically bias in attribute judgments was indiscriminate and applied equally to Sub-
 753 ject and Object features. The attribute judgments of participants who made correct syllogism
 754 responses in only the Make-Believe Condition (Make-Believe only Response Group), when
 755 asked to make believe a fictional entity were as likely to be consistent with or in violation
 756 of their real-world knowledge about the entities That is, they made attribute judgments about
 757 pretended entities without being constrained by their empirical knowledge about those entit-
 758 ies. This lack of empirically constraint in attribute judgments was indiscriminately applied
 759 equally to Subject and Object features of the pretend entity. Finally, the attribute judgments
 760 of those participants who made consistently correct syllogism judgments in both conditions
 761 (Both Response Group) were significantly above chance, reflecting an empirical constraint
 762 in their attribute judgments. For these participants, the empirical constraint was stronger for
 763 judgments about Subject than Object features in both the Pretend and Make-Believe condi-
 764 tions.

765 The upshot is that participants whose Make-believe but not Hypothetical zyllogistic perform-
 766 ance was consistently correct characterized the pretended entity in an empirically unconstrained
 767 manner. The unconstrained use of imagination is exemplified by one kindergarten child mentally
 768 created Rover, who not only meows and but also wags it tail, purrs and eats mice but does not
 769 growl. However, those whose performance on Make-believe syllogisms was consistently correct
 770 were more constrained by empirical knowledge in characterizing their pretend supposition if
 771 they additionally performed consistently correctly on the Hypothetical syllogisms. These partic-
 772 ipants' pretend entities were notable for being more empirically constrained in Subject than
 773 Object features of the premise. For example, a 3rd–4th-grade student characterized Rover the
 774 dog who meows just like any other dog, as growling and wagging its tail. However, although
 775 the 10-year-old denied that the meowing dog eat mice, she thought it might purr, given that it
 776 meows.

777 9. Discussion

778 Study 2 was designed to better test theories of representing and reasoning about belief-
779 contravening suppositions. Piagetian Theory holds that representing and reasoning about
780 belief-contravening make-believe suppositions would involve fundamentally different cognitive
781 processes than hypothetical ones. There was some evidence in support of this position in that con-
782 sistent performance on hypothetical suppositions generally emerged later than similar
783 performance on make-believe suppositions. Additionally, there were developmental changes in
784 participants' reasoning about the supposed attributes of make-believe and hypothetical entities.
785 Judgments about the supposed attributes of make-believe entities were made in an arbitrary man-
786 ner, sometimes consistent with and sometimes in violation of empirical knowledge, by those who
787 were consistently correct in their syllogistic reasoning with make-believe suppositions. These
788 participants were generally younger than those who were consistently correct in their syllogistic
789 reasoning with make-believe and hypothetical suppositions. The latter group made judgments
790 about the supposed attributes of make-believe and hypothetical entities in a non-arbitrary manner,
791 reflecting a preference for empirically based attributes, particularly for the subject features. The
792 changes in how the supposed attributes of make-believe entities were reasoned about in light of
793 the development of correct performance on hypothetical syllogisms suggests the emergence of
794 a general and integrated skill for representing and reasoning about belief-contravening suppo-
795 sitions.

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

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

823 suppositions and reason on their basis was made clearer to participants in Study 2 than it was in
824 Study 1.

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

837 Those participants who were consistently correct in only the make-believe condition were
838 arbitrary in their attribute judgments in that condition. These participants were unconstrained
839 by their empirical knowledge, demonstrating little attention to or need for realistically reconcil-
840 ing their belief-contravening suppositions with their prior beliefs and knowledge. Instead of
841 realistically reconciling suppositions with their knowledge and beliefs they were on flights of
842 fancy, creating fantastic fictional worlds. There was no attempt to make the fictional world
843 realistic although it was obviously constrained by logic, as their syllogistic performance sug-
844 gests. These participants' flight of fancy did not help them to think through the hypothetical
845 supposition request, to "imagine what the real world would be like if . . ." That is, the unreal-
846 istic reconciliation between the make-believe supposition and real-world beliefs and knowledge
847 in this group may have been a reason for their poor performance in the Hypothetical Condi-
848 tion.

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

856 This difference in reasoning in the latter two groups appears to reflect the purpose or goals
857 of entertaining make-believe and hypothetical suppositions. Make-believe suppositions were
858 described as being entertained fancifully, as an end in itself, without the goal of comparing
859 or contrasting such suppositions to the real world. Adopting a supposition that is unconstrained
860 by empirical knowledge is in keeping with the fanciful goal of make-believe. The creation of
861 such a world is relatively less cognitively demanding because of the limited extent of reconcil-
862 iation with real-world knowledge that is required. In contrast, hypothetical suppositions were
863 described as being entertained seriously, as a means to create an alternative world with features
864 that could be compared to and contrasted with features in the real world. Adopting suppositions
865 and expanding on their implications in a manner to make it consistent with real world would be
866 very important to effectively and successfully reason in a hypothetical manner. However, creating
867 an alternative world which can be compared to and contrasted with the real world would require
868 a good deal of reconciliation with prior beliefs knowledge, making it relatively more cognitively
869 demanding.

870 It is unclear why the group whose syllogistic performance was consistently correct in both
871 conditions made attribute judgments in both the make-believe and hypothetical conditions so
872 similarly. One explanation is that, since the group was composed largely of college students,
873 perhaps the hypothetical mode for processing belief-contravening suppositions predominated.
874 The child's use of fantasy in the service of make-believe may give way to the more hypothetical
875 uses by college students.

876 The results of Study 2 support the Situation Model theory's account of representing and
877 reasoning about belief-contravening suppositions. The theory holds that similar processes for
878 compartmentalizing suppositions from real-world knowledge and integrating the former with
879 the latter are central in the processing of belief-contravening suppositions. The greater difficulty
880 involved with representing and reasoning about hypothetical than make-believe suppositions may
881 be related to the manner by which such suppositions are reconciled with real world beliefs and
882 knowledge. To construct realistic hypothetical suppositions, the suppositions must be made con-
883 sistent with real-world knowledge and beliefs. The process of reconciling belief-contravening
884 hypothetical suppositions with real-world beliefs and knowledge occurs despite compartmen-
885 talizing the latter from the former, through such processes as Harris and Kavanaugh's (1993)
886 "flagging model." To construct fantastic make-believe worlds, the suppositions must be made
887 distinct from real world knowledge and beliefs. That is, beyond their compartmentalization,
888 make-believe suppositions can be further distinguished from real-world knowledge through the
889 limited reconciliation of such suppositions with real-world knowledge. The result of this is that
890 less reconciliation is necessary for make-believe suppositions and more is necessary for hypo-
891 thetical suppositions, making the process of reasoning from the former easier than from the
892 latter.

893 10. General discussion

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

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

913 Reasoning about belief-contravening suppositions in both hypothetical and make-believe con-
914 texts is related in Situation Models by evoking similar processes for compartmentalization of

915 the suppositions and integration of them with prior beliefs and knowledge. But reasoning about
916 suppositions in the two contexts is distinguished by the extent to which the suppositions are rec-
917 onciled with real-world beliefs and knowledge, with the assumption that fanciful, make-believe
918 suppositions would involve less systematic reconciliation than would serious, hypothetical ones
919 because only the latter are purposely constructed to be realistic to allow for comparisons and
920 contrasts with the real-world.

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

940 The goal of creating hypothetical worlds as close as possible to the real world is a cen-
941 tral feature in hypothetical thinking about possible worlds (Lewis, 1986). One example of
942 such a possible world is Putnam's (1975) "twin earth," to which Lillard (2000) appealed as
943 a model for a decoupled pretend representation. But as we have seen, attribute judgments
944 for make-believe suppositions may not be made with a verisimilitude goal in mind. In con-
945 trast, such a verisimilitude goal for attribute judgments was only honored by those whose
946 performance on hypothetical syllogisms was consistently correct. Their judgments regarding
947 the supposed attributes of hypothetical entities were constrained by empirical knowledge, par-
948 ticularly for subject features. Their judgment pattern keeps the subject features of the belief-
949 contravening supposition consistent with real-world knowledge and beliefs, so that although
950 unusual, a meowing dog has features that are consistent with most other real-world knowl-
951 edge and beliefs about dogs. The empirical constraint on these participants' attribute judgments
952 for supposed hypothetical entities also applied to their judgments for supposed make-believe
953 entities. As noted, it is not clear why such a pattern emerged, although the predominance
954 of hypothetical over make-believe processing of suppositions in the lives of college students
955 (who were mostly the ones who performed correctly in both conditions) may be one rea-
956 son.

957 The claim that situation models underlie reasoning with belief-contravening suppositions
958 suggests that pretend, fictional and hypothetical contexts are similar to each other as each
959 evokes related forms of narrative processing. Narrative approaches to studying the mind are not
960 new, highlighted most notably by Bruner's (1986) distinction between narrative and paradigm-
961 atic (logico-scientific) modes of thought. In his discussion of a narrative mode, Bruner

962 (1986) emphasized its “subjunctivizing” nature, which involves use of the imagination in
963 the service of conceiving of a world other than the world of facts. He writes (p. 26), “To
964 be in the subjunctive mode is, then, to be trafficking in human possibilities rather than in
965 settled certainties.” Reasoning about belief-contravening make-believe suppositions fits this
966 quality of narrative thinking quite well. Indeed, as previously noted, situation models of
967 understanding fiction have been theoretically applied to children’s understanding of pretense
968 (Gerrig & Pillow, 1998; Harris, 1998, 2000; Harris & Kavanaugh, 1993; Nicolopoulou, in
969 press).

970 New to this literature is the present argument that the same narrative mode of thinking
971 underlying belief-contravening make-believe suppositions may also underlie reasoning about
972 belief-contravening hypothetical suppositions. The narrative treatment of belief-contravening sup-
973 positions is consistent with Rescher’s (1961, 1964) notion that there is no logical or mechanical
974 way to reconcile belief-contravening suppositions with prior beliefs and knowledge. Rescher’s
975 (1964) interest was in explicating rules for rejecting and retaining prior knowledge and beliefs
976 so that suppositions would be reconciled in a manner that is logically complete and consis-
977 tent with prior knowledge and beliefs. Such a resolution would be necessary for the use of
978 suppositions in the service of goals associated with Bruner’s paradigmatic mode of think-
979 ing, including inferring causes and testing hypotheses. Further research could more system-
980 atically test this central finding of the paper that distinguished but related narrative processes
981 underlie reasoning about belief-contravening suppositions in make-believe and hypothetical con-
982 texts.

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995 **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 hippity-hop. Imagine what the real world would be like if giraffes hippity-hop.

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

Tallie is a giraffe. Does Tallie hippity-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	Imagine what the real world would
world that turkeys make webs.	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

Subject2: 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	Imagine what the real world would
world that dogs meow.	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	Imagine what the real world would
world that cows make honey.	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	Imagine what the real world would be
that elephants hiss & rattle their tails.	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

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