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Preschoolers' generation of different types of counterfactual statements and theory of mind understanding

Nicole R. Guajardo, Kandi Jo Turley-Ames*

Department of Psychology, Idaho State University, Campus Box 8112, Pocatello, ID 83209-8112, USA

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Abstract

Two studies examined associations between theory of mind performance and counterfactual thinking using both antecedent and consequent counterfactual tasks. Moreover, the studies examined children's abilities to generate different types of counterfactual statements in terms of direction and structure. Participants were 3-, 4-, and 5-year-old children ($N = 81$ and 103 in Studies 1 and 2, respectively). In both studies overall number of counterfactual statements generated as well as generation of specific types of counterfactuals accounted for significant variance in theory of mind performance beyond age and language. Results also indicated that children, similar to adults, generated certain types of counterfactuals with more ease than others. Data suggest that counterfactual thinking accounts, at least partially, for children's theory of mind performance. Implications for current understanding of counterfactual reasoning and theory of mind development are discussed.

Keywords: Preschooler; Counterfactual statement; Theory of mind understanding

Children, on average, develop foundational theory of mind understanding by 4 years of age, though an understanding of more complex concepts (e.g., consciousness, forgetting, attention) develops later (Flavell, Green, Flavell, & Lin, 1999; Pillow & Lovett, 1998). Currently, researchers are interested in understanding the bases for theory of mind development. Factors identified to account for individual differences in theory of mind performance include, but are not limited to, language skills (Astington & Jenkins, 1995; Jenkins &

* Corresponding author.
E-mail addresses: guajnico@isu.edu (N.R. Guajardo), turlkand@isu.edu (K.J. Turley-Ames).

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Astington, 1996), pretense (e.g., Taylor & Carlson, 1997), family size (e.g., Jenkins & Astington, 1996; Lewis, Freeman, Kyriakidou, Maridaki-Kassotaki, & Berridge, 1996; Perner, Ruffman, & Leekam, 1994; Ruffman, Perner, Naito, Parkin, & Clements, 1998), family discourse (Brown, Donelan-McCall, & Dunn, 1996; Dunn, Brown, & Beardsall, 1991; Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991), working memory (Davis & Pratt, 1995; Gordon & Olson, 1998; Jenkins & Astington, 1996), and inhibitory control (Carlson & Moses, 2001; Carlson, Moses, & Hix, 1998; Hughes, 1998; Leslie & Polizzi, 1998). The primary purpose of the present study was to examine the extent to which individual differences in counterfactual thinking account for theory of mind understanding. A second purpose was to examine young children's abilities to generate different types of counterfactual statements as examined with adults.

1. Counterfactual thinking

Counterfactual thinking, generally, refers to an understanding of events that are "counter to reality" or false (e.g., Harris, German, & Mills, 1996; Kavanaugh & Harris, 1999; Riggs, Peterson, Robinson, & Mitchell, 1998) and involves comparing reality to an imagined alternative (Kahneman & Miller, 1986; Kahneman & Tversky, 1982). Perhaps the first signs of counterfactual thinking emerge in the second year of life with pretend play (Amsel & Smalley, 2000; Richards & Sander- son, 1999), which involves a child acting in a way inconsistent with reality. Other studies of counterfactual thinking in childhood have focused on children's abilities to reason about situations that are inconsistent with current events (e.g., German, 1999; Harris et al., 1996; Leevers & Harris, 2000; Riggs et al., 1998). Harris et al. conducted a series of three studies in which preschool aged children were asked to consider how events could have been different. For example, in their first study children watched as a doll left muddy footprints as she walked across the floor. Children were asked if the floor would have been dirty if the doll had taken off her shoes. In subsequent studies Harris et al. examined whether children could determine which antecedents would and would not have changed the outcome and whether preschool aged children could generate counterfactual statements spontaneously (e.g., How could the event have been prevented?). Children as young as 3 years of age were able to reason counterfactually with regard to alternative outcomes.

2. Counterfactual thinking and theory of mind

Counterfactual reasoning could account, at least partially, for theory of mind understanding. Riggs et al. (1998) told children two stories, variants of the unexpected change task (Wimmer & Perner, 1983) with both false belief and counterfactual test questions. In one of their stories chocolate was moved from one location to another. Children were asked, "Where does X think the chocolate is?" (false belief) and, "If Mummy had not baked a cake, where would the chocolate be?" (counterfactual). Thus, their counterfactual tasks involved asking preschool aged children to consider how the consequence would be different if the antecedent were changed. Regardless of age and language skills, children's abilities to reason counterfactually predicted their false belief performance. Using a similar approach, Peterson and Bowler (2000) generalized such findings to individuals with autism.

Peterson and Riggs (1999) suggested that children pass theory of mind tasks around 4 years of age because they are capable of modified derivation: They can ignore what they know and focus upon conflicting information. For example, on Wimmer and Perner's (1983) unexpected change task, children are aware that chocolate has been moved, but to answer correctly they must ignore that information and focus on the character's knowledge of where the chocolate used to be. Peterson and Riggs argued that younger children have difficulty adhering to the instruction to ignore their knowledge (i.e., reason about information that is counterfactual). They suggest young children's inability to process conflicting information prevents them from passing the unexpected change/Maxi (Wimmer & Perner, 1983), representational change (Gopnik & Astington, 1988), forgetting (Perner, Leekam, & Wimmer, 1987), and "kitten" (Wellman & Bartsch, 1988) tasks. Similarly, young children might have difficulty with counterfactual reasoning because they must ignore the known sequence of events to construct an alternative.

Perner (2000) suggested that the common theme between theory of mind and counterfactual reasoning is an understanding of "aboutness," the understanding that propositions refer to (are about) the real world. Both false belief performance and counterfactual thinking require children to reference points in the real world (location, events) that are different from reality. For example, on the Maxi task children must reference where an object was previously rather than where it is now. Perner has emphasized the importance of representational understanding whereas Peterson and Riggs (1999) have argued for the importance of processing factors beyond representational understanding.

The present study is based upon the idea that theory of mind performance is a special case of counterfactual thinking. More specifically, theory of mind concepts are thought to involve applications of counterfactual understanding to mental states. Much as Peterson and Riggs (1999) suggested, children must be able to consider the current state of the world as well as how it could be different to pass theory of mind tasks. Though it is suspected that counterfactual thinking continues to develop across the preschool years, it is proposed that children must be capable of counterfactual thinking before they can consider thoughts and beliefs that counter reality.

3. Assessing counterfactuals

Whereas some counterfactual tasks have required children to identify an outcome given a specific antecedent ("If there had not been a fire, where would Peter be?"; Riggs et al., 1998), others have asked children to generate antecedents that would have produced a specific outcome ("What should Sally have done instead so that her fingers wouldn't get all inky?"; Harris et al., 1996). Throughout remaining sections of this paper, counterfactual tasks that require children to alter a consequence will be called "consequent tasks" whereas those that require them to alter an antecedent will be called "antecedent tasks." Whereas Riggs et al. focused on the former approach and its relation to theory of mind ability, the present study utilized the latter approach. Instead of asking individuals to identify a single outcome (Peter would be in bed.) that would result from a given antecedent, antecedent tasks allow individuals to generate multiple possible antecedents (Peter didn't answer the phone, the phone was broken, there was not a fire) to produce an identified outcome. It was believed that this approach would allow for a more specific examination of children's counterfactual reasoning than have previous approaches used in the developmental literature.

Another asset of the antecedent task is that it allows an examination of children's abilities to generate different types of counterfactual statements. In the social psychological literature, counterfactual statements have been classified both according to direction and structure (Roese, 1994). First, counterfactual statements often differ in terms of direction, either upward or downward. Upward counterfactuals compare reality to a better alternative antecedent (and therefore better consequent) while downward counterfactuals compare reality to a worse alternative antecedent (and therefore consequent) (Markman, Gavanski, Sherman, & McMullen, 1993). The example of Bill's car accident will be used for clarification. An example of an upward counterfactual is, "If only I had taken my usual route." If Bill had taken his usual route, the situation would be better because, presumably, he would not have gotten into an accident. An example of a downward counterfactual is, "At least I was not seriously hurt," implying that the current situation is not as bad as it could be. Second, counterfactual statements often differ in terms of structure, either additive or subtractive. Additive counterfactuals add an element to an antecedent while subtractive counterfactuals remove an element (Roese & Olson, 1993). An example of an additive counterfactual is, "If only I had kept my eyes on the road, I would not have hit that truck." The idea of "keeping my eyes on the road" was added to the series of events associated with Bill's car accident. An example of a subtractive counterfactual statement is, "If only the truck had not run the stop sign." In this case, Bill is considering an alternative situation in which he has removed the event of the truck running the stop sign. Each counterfactual statement can be classified according to both direction and structure. For example, the additive counterfactual, "If only I had kept my eyes on the road," is also upward, implying that the accident would have been avoided had Bill kept his eyes on the road.

4. Present study

The present research had three purposes. The primary purpose of the present set of studies was to extend the work of Riggs et al. by examining young children's performance on theory of mind and antecedent counterfactual tasks. Antecedent counterfactual tasks were used in both studies and consequent counterfactual tasks were included in Study 2. It was hypothesized that both types of counterfactual reasoning would account for significant variance in theory of mind ability.

A second purpose was to examine patterns of counterfactual reasoning across the preschool years, from 3 to 5 years of age. Children demonstrate an understanding of false belief, the cornerstone of theory of mind development, around 4 years of age. Thus, the present study included 3-, 4-, and 5-year-olds. Given data indicating a relationship between children's understanding of these concepts, theory of mind and counterfactual thinking performance were expected to improve across the preschool period.

A third purpose of the present studies was to explore whether children can generate different types of counterfactual thoughts, as do adults. Among adults, upward, downward, and additive counterfactuals are generated most often while subtractive counterfactuals are less common. Adults (e.g., Gavanski & Wells, 1989; Gleicher et al., 1990; Kahneman & Miller, 1986; Kahneman & Tversky, 1982; Landman, 1987; Sanna & Turley, 1996; Wells, Taylor, & Turtle, 1987) and children (German, 1999) generate counterfactuals more often following negative or unexpected outcomes than positive or expected outcomes. Several studies have shown that adults undo, or improve, aversive outcomes by mentally adding new elements or behaviors that were not included in the original event (Davis, Lehman, Wortman, Silver, & Thompson, 1995; N'gbala & Branscombe, 1997; Roese & Olson, 1993; Sanna & Turley, 1996). Adults generate downward counterfactuals to enhance affect in these same situations, but when preparation for the future is not necessary (Markman et al., 1993). Subtractive counterfactuals are generated typically following a positive outcome (Roese & Olson, 1993; Sanna & Turley, 1996). Recent research, however, indicates that subtractive counterfactuals are generated less often (Roese, Hur, & Pennington, 1999) and processed less automatically (Turley-Ames & Whitfield, 2000) than additive counterfactuals. The present study assessed whether children generated upward and downward counterfactuals when prompted, and whether they generated additive and subtractive counterfactuals spontaneously. It was hypothesized that children, like adults, would generate few subtractive counterfactuals.

5. Study 1

5.1. Method

5.1.1. Participants

Participants were 81 three- to five-year-old children: 24 three-year-olds (14 girls and 10 boys; mean age of 41 months; range 33–47 months), 32 four-year-olds (18 girls and 14 boys; mean age of 54 months; range 49–59 months), and 25 five-year-olds (12 girls and 13 boys; mean age of 66 months; range 6–72 months). Children attended one of two preschools in a small, rural city. Children were primarily Caucasian and from middle-class homes.

5.1.2. Measures

5.1.2.1. Language. Previous research has indicated that language comprehension is correlated with theory of mind performance (e.g., Astington & Jenkins, 1995), thus, the *Test for the Auditory Comprehension of Language — Revised* (TACL-R; Carrow-Woolfolk, 1985) was administered to assess children's language comprehension. The TACL-R consists of three subscales assessing various aspects of verbal ability (word comprehension, morphology, and sentence comprehension). All three subscales were administered to each child. For each item, the experimenter read a word, group of words, or sentence to the child, and instructed the child to point to one of three pictures that best corresponded to the experimenter's utterance. Children received 1 point for each correct response. Raw scores, with a possible range of 0–120, were computed by compiling scores across the three subscales. The inclusion of this measure allowed examination of the relationship between theory of mind performance and counterfactual thinking irrespective of language ability.

5.1.2.2. Theory of mind assessment. Children's theory of mind was assessed using Wimmer and Perner's (1983) standard unexpected change task (see also Gopnik & Astington, 1988), a two-part unexpected contents task (Bartsch & Wellman, 1989; Lewis & Osborne, 1990), and two deception tasks (Lalonde & Chandler, 1995; Wimmer & Perner, 1983). These tasks were selected because they are of the most commonly used theory of mind tasks. Multiple measures of the concept of mental events were utilized in an attempt to produce a range of scores for assessing individual differences in theory of mind performance. For each task, children only received credit if they answered the control questions correctly. Children received a total score ranging from 0 to 7 on the theory of mind assessment. The sex of the character in each story matched that of the child and all stories were acted out with props.

In the unexpected change task, children were told a story about Max/Maxi and his/her mother. In the story, Maxi and her mother return from the grocery store and put the chocolate that they bought in the blue cupboard. Then, while Maxi is out of the room, Mother moves the chocolate to the red cupboard. Prior to being asked the test questions, children were asked three, comprehension questions to ensure that they understood the story: (1) "Where did the chocolate used to be?"; (2) "Where is the chocolate now?"; and (3) "Did Maxi see the chocolate being moved?" If children answered any of these questions incorrectly, they were corrected once, and the test questions were readministered and scored (see Watson, Nixon, Wilson, & Capage, 1999, for a similar approach). Next, children were asked the test questions, "Where will Maxi first look for the chocolate when she comes back?" Children received 1 point for a correct response.

The second task was modeled after work of Wimmer and Perner (1983) and involved a character tricking his/her sibling. Children were told, "Here is Bruce/Pam. He/She took the candy out of the candy box and put it in this crayon box so that his/her brother/sister would not find it. Bruce/Pam did not want his/her brother/sister to eat the candy before Bruce/Pam got any. When Bruce's/Pam's brother/sister comes into the room he/she asks Bruce/Pam where the candy is. Bruce/Pam decides to tell his/her brother/sister something *completely wrong* so his/her brother/sister will *not* find the candy." Next, children were asked the test question, "Where will Bruce/Pam *say* the candy is?" Children received a score of 1 for a correct response of "the candy box," and a score of 0 for an incorrect response, "the crayon box." Finally, children were asked the control question, "Where is the candy really?"

The next two tasks involved the unexpected contents task. Both components (self and other) of the unexpected contents task included a prompt for children who did not answer the initial test question correctly. The prompt questions were included to capture additional variability in performance with the assumption that some children would be able to answer correctly without the prompt and others would not. In general, a larger proportion of children answer correctly with the prompt, suggesting they are easier than the standard question (Lewis & Osborne, 1990). Cutting and Dunn (1999) and Watson et al. (1999) have used similar approaches. The first task assessed children's understanding of their own representational change (Lewis & Osborne, 1990). Children were shown a Band-Aid® box and asked, "What do you think is inside the box?" Children then were shown the contents of the box, a toy car. Next the box was closed and children were asked the first test question, "What did you think was in the box?" If children responded that they thought Band-Aids®

were in the box, they received a score of 2. If children did not answer this first question correctly, the experimenter provided a prompt: “What did you think was in the box *before* I took the top off?” If children answered the prompt question correctly (e.g., he or she thought Band-Aids® were in the box), they received a score of 1. Children who answered both of these questions incorrectly received a score of 0. Following the test questions, children were asked a memory control question, “What is really in the box?” to ensure they remembered the contents of the box.

The second unexpected contents task was a false belief explanation task. Children were shown the same Band-Aid® box and a similar, unmarked box containing Band-Aids®. Children were shown what was in the new box and reminded what was in the Band-Aid® box (“There are Band-Aids in this box and a toy car in the Band-Aid box.”) to ensure that children who failed the self-representational change task were not prevented from passing the explanation task. Following the procedure of Bartsch and Wellman (1989), children were shown a doll and told that Bill/Sarah has a cut and he/she wants a Band-Aid®. The doll then approached the Band-Aid® box and children were asked the critical test question, “Why do you think he/she is looking in there?” Children who gave the correct response (“Bill/Sarah looked in the Band-Aid® box because he/she *thought* it contained Band-Aids®.”) received a score of two. If children either did not respond or did not mention beliefs, the experimenter provided a prompt, “What does Bill/Sarah think?” Children received a score of 1 for a correct, prompted response. Children who answered both questions incorrectly received a score of 0. Finally, children were asked a control question, “Are the Band-Aids® there really?” to ensure that they recalled the true contents of the box.

Finally, children were led through a task that involved actively deceiving a character (see Lalonde & Chandler, 1995). Children were introduced to a doll (John/Sue). Next, children were told that John/Sue knows there is candy in the green drawer, but that he/she has to leave the room for a while. While John/Sue is “gone” the experimenter tells the children, “Let’s play a trick on John/Sue. Let’s move the candy to the blue drawer.” The child then moved the candy to the blue drawer. As with the unexpected change task, children were asked three comprehension questions to ensure that they understood the story: (1) “Where did the candy used to be?”; (2) “Where is the candy now?”; and (3) “Did John/Sue see the candy being moved?” If children answered any of these questions incorrectly, they were corrected once, and the test questions were readministered and scored. Next, they were asked the test question, “When John/Sue comes back into the room, where will he/she first look for the candy?” Children received a score of 1 for each correct response of “the green drawer,” and a score of 0 for each incorrect response, “the blue drawer.”

5.1.2.3. Counterfactual thinking (antecedent tasks). For each of the counterfactual tasks, children were asked to imagine themselves in a hypothetical situation. For example, in one scenario children were told the following story: “Imagine that you are playing outside in the muddy yard. You are thirsty so you go inside to the kitchen to get a drink of juice. You walk through the mud, you step over the doormat, and you keep your shoes on. Because your shoes are muddy, you get dirt all over the floor.” Then the children were asked, “What could you have done so that the kitchen floor would not have gotten dirty?” After each response children were asked, “Can you think of anything else?” until they did not provide any more responses to encourage generation of as many answers as possible. The other scenarios involved avoiding breaking a glass, keeping nice clothes clean, and breaking a crayon while drawing a picture. Across the four scenarios, two were designed to encourage upward counterfactuals (e.g., "What could you have done so that you would have drawn the rest of the picture?") and two were designed to encourage downward counterfactuals (e.g., "What could you have done so your clothes would have gotten dirty?").

5.1.2.4. Coding of the counterfactual measure. Each statement first was coded as either a counterfactual statement or as other or irrelevant. Children received credit for a counterfactual statement if they made a logical response (e.g., "Get ice-cream everywhere" in response to, "What could you have done so that your clothes would have gotten dirty?). "Other" statements were those that were related to the topic, but were not counterfactual statements (e.g., "You would look pretty" in response to, "What could you have done so that your clothes would have gotten dirty?"). "Irrelevant" statements were not related to the question (e.g., "Candy bar" in response to, "What could you have done so that you would have drawn the rest of the picture?"). Counterfactual statements were coded further according to both direction (upward and downward) and structure (additive and subtractive). Statements that were better than reality were coded as "upward," while statements that were worse than reality were coded as "downward." Statements that added antecedents to reconstruct reality were coded as "additive," while statements that removed antecedents to reconstruct reality were coded as "subtractive." See Table 1 for examples. The total number of each type of counterfactual was calculated for each child. Two individuals blind to children's age and theory of mind performance coded all of the counterfactual data; a third coder settled disagreements. Interrater reliability was high, Cohen's kappa of .95.

5.1.3. Procedure

Children were tested individually on two separate occasions in a quiet part of their school. During one 10- to 20-min session children received the language measure, and during

Table 1
Examples of children's counterfactual statements according to direction (upward and downward) and structure (additive and subtractive)

Upward scenario: Imagine that you are playing outside in the muddy yard. You are thirsty so you go inside to the kitchen to get a drink of juice. You walk through the mud, you step over the door mat, and you keep your shoes on. Because your shoes are muddy you get dirt all over the floor.	
Test question: "What could you have done so the kitchen floor would *not* have gotten dirty?"	
Upward-additive response:	"Wipe your shoes off before you get into the house."
Upward-subtractive response:	"Wouldn't play in the mud."
Downward scenario: Imagine that your family is having a party for Grandma. For the special event, you put on your really nice clothes. At the party you eat ice cream, drink red punch, and play games. You are very careful and you keep your clothes nice and clean.	
Test question: "What could you have done so your clothes *would* have gotten dirty?"	
Downward-additive response:	"Get messy with cake."
Downward-subtractive response:	"I would not have been careful with my punch."[a]

[a] Statement created as an example; no children generated downward-subtractive statements.

Table 2
Intercorrelations of the theory of mind tasks

	1	2	3	4	5
Study 1 ($N = 79$)					
1. Unexpected change	**	.43	.29	.39	.56
2. Sibling deception		**	.34	.37	.55
3. Unexpected contents — self			**	.35	.57
4. Unexpected contents — other				**	.52
5. Active deception					**
Study 2 ($N = 97$)					
1. Unexpected change	**	.59	.55	.52	.54
2. Sibling deception		**	.46	.51	.47
3. Unexpected contents — self			**	.46	.42
4. Unexpected contents explanation — other				**	.55
5. Active deception					**

Note: *AllP*'s $< .01$.

Table 3
Means and (standard deviations) of theory of mind task performance

Task	Study 1 ($N = 79$)	Study 2 ($N = 97$)
Unexpected change	0.43 (0.50)	0.46 (0.50)
Sibling deception	0.52 (0.50)	0.44 (0.50)
Unexpected contents — self	1.05 (0.90)	1.04 (0.96)
Unexpected contents explanation — other	0.63 (0.70)	0.73 (0.84)
Active deception	0.62 (0.49)	0.63 (0.49)

a second 10- to 15-min session they completed the theory of mind and counterfactual measures. The theory of mind tasks consistently preceded the counterfactual reasoning tasks. A different research assistant administered the tasks in the first session and those in the second session to reduce any effects of familiarity with the experimenter. The research assistant recorded each child's responses during the sessions. Sessions were separated by 1–24 ($M = 7.15$) days.

5.2. Results

5.2.1. Preliminary analyses

A principal components analysis was used to analyze the correlations among the five theory of mind tasks. This analysis yielded one component with an eigenvalue greater than one (2.77) and loadings ranging between 0.68 and 0.88. Intercorrelations are presented in Table 2.[1] An additional principal components analysis was conducted analyzing the partial correlations between the five tasks controlling for the effects of age and language. This analysis yielded consistent results with one component with an eigenvalue greater than one

[1] Individual task score data were missing for two participants, thus the intertask correlations were conducted with $N = 79$. Composite scores were available for all 81 participants and were used in subsequent analyses.

Table 4
Mean and (standard deviation) language, theory of mind, and antecedent counterfactual reasoning in Study 1

	Age			Total[a] ($N = 76$)	Complete sample[b] ($N = 81$)
	3-year-olds ($n = 21$)	4-year-olds ($n = 32$)	5-year-olds ($n = 23$)		
Language	34.95 (12.91)	58.41 (16.76)	76.91 (12.97)	57.53 (21.64)	57.27 (23.12)
Theory of mind	1.14 (1.59)	3.66 (2.04)	4.83 (1.59)	3.32 (2.28)	3.30 (2.25)
Antecedent counterfactual reasoning					
Counterfactuals	1.81 (1.40)	3.97 (3.69)	5.57 (2.31)	3.86 (3.13)	3.77 (3.08)
Upward	1.14 (0.96)	1.78 (1.47)	2.52 (1.20)	1.82 (1.36)	1.78 (1.35)
Downward	0.67 (1.02)	2.19 (2.65)	3.04 (1.55)	2.03 (2.17)	1.99 (2.12)
Additive	1.67 (1.49)	3.47 (3.26)	5.00 (2.49)	3.23 (2.90)	3.35 (2.89)
Subtractive	0.14 (0.48)	0.50 (0.80)	0.57 (0.95)	0.42 (0.79)	0.42 (0.77)
Other	2.71 (2.39)	2.41 (1.98)	1.52 (1.38)	2.16 (1.96)	2.22 (1.98)
Irrelevant	0.48 (0.98)	0.10 (0.30)	0.00 (0.00)	0.16 (0.56)	0.17 (0.57)

[a] For the analyses of age, only the data of children between 36 and 60 months of age were included.
[b] Complete sample includes all children, ranging in age from 33 to 70 months, who participated in the study.

(2.13) and loadings ranging between 0.48 and 0.83. The five-item scale had an internal consistency of 0.76. Given the consistent principal components analyses and the acceptable level of internal consistency, the sum of scores across tasks constituted a composite theory of mind score from 0 to 7. Means and standard deviations for each task are reported in Table 3.

Males and females performed similarly on the theory of mind and counterfactual reasoning tasks, thus sex was not considered further. As expected, age and language comprehension scores were related to children's performance on theory of mind, r's(80) $= .62, .61$; P's $< .001$, and counterfactual reasoning, r's(80) $= .52, .51$; $P < .001$, tasks, respectively. Theory of mind performance and antecedent counterfactual reasoning scores were correlated as well, $r(80) = .68$, $P < .001$. There were no missing data. Descriptive statistics for language, theory of mind, and antecedent counterfactuals are presented in Table 4.

5.3. *Overview of critical analyses*

Two different types of analyses were conducted to address the hypotheses. First, hierarchical regression analyses were conducted to determine the extent to which total number of and direction and structure of counterfactuals generated account for theory of mind performance beyond age and language. Each hierarchical analysis was carried out in two steps. In the first step, age and language were entered as control variables predicting theory of mind performance. In the second step, counterfactual variables (i.e., total, direction, structure) were entered as predictors. For each step, we report the increment in variance accounted for by the variables entered in that step, the unstandardized beta weights, and the squared semipartial correlations (sr^2), which indicate the proportion of unique variance accounted for by each variable (Cohen & Cohen, 1983).

Second, ANOVAs were conducted to examine how counterfactual thinking changes across 3, 4, and 5 years of age. Separate analyses were conducted for total counterfactuals,

Table 5
Hierarchical regression analysis of antecedent counterfactuals as a predictor of theory of mind scores: Study 1

Step	Inc. R^2	F-change	β	t-value	sr^2
Step 1	.418	27.98**			
Age (months)			.082	2.619*	.051
Language			.029	2.047*	.031
Step 2	.155	28.02**			
Number of counterfactuals			.343	5.294**	.155

Note: Inc. R^2: increment in variance accounted for; β: unstandardized regression coefficient; sr^2: squared semi-partial correlation.

* $P < .05$.

** $P < .01$

direction, and structure. The analyses were conducted first without consideration of language, and then they were conducted with language as a covariate. Though these analyses could be considered redundant, it was believed that such an approach would allow for an examination of the role of language in the production of different types of counterfactuals. In addition, the theory of mind variable was included in one analysis to determine whether the developmental pattern for both theory of mind and counterfactual reasoning ability were similar.

5.3.1. Theory of mind and counterfactual reasoning performance

To examine the relationship between theory of mind performance and number of counterfactuals generated, a hierarchical regression was performed (see Table 5). Age and language were entered in the first step with theory of mind scores as the dependent variable. These variables accounted for 42% of the variance in theory of mind scores, $F(2, 78) = 27.98$, $P < .001$, with each variable contributing uniquely. The unstandardized beta coefficients for both age and language were significant at $P < .05$. Total number of counterfactuals generated was entered in the second step, producing a significant R^2 change of 16%, $F(1, 77) = 28.02$, $P < .001$. The final regression equation accounted for 57% of the variance in theory of mind scores, $F(3, 80) = 34.46$, $P < .001$. The beta coefficient for counterfactuals (.34) was significant, $P < .001$, in the final equation. Beyond age and language comprehension, the ability to consider how alternative antecedents would change an outcome predicted children's abilities to reason about their own or another's thoughts.

5.3.2. Theory of mind performance and generation of types of counterfactuals

To explore the relationship between types of counterfactuals generated and theory of mind performance, two regressions were conducted with theory of mind as the dependent variable. Two separate analyses were conducted because direction and structure of counterfactuals were not independent. For example, when a child generated an additive counterfactual, that statement also was coded as either upward or downward. The first analysis examined counterfactual direction (upward vs. downward; see Table 6). In the first step, age and language were entered, and the results were identical to those reported above. The numbers of upward and downward counterfactuals generated were entered in the second step. These variables accounted for an additional 16% of the variance in theory of mind

Table 6
Hierarchical regression analysis of types of counterfactuals as predictors of theory of mind scores: Study 1

Step	Inc. R^2	F-change	β	t-value	sr^2
Direction					
Step 1	.418	27.977***			
Age (months)			.082	2.619*	.051
Language			.029	2.047*	.031
Step 2	.159	14.266***			
Downward counterfactual			.463	2.829**	.045
Upward counterfactual			.284	2.908**	.047
Structure					
Step 1	.418	27.977***			
Age (months)			.082	2.619*	.051
Language			.029	2.047*	.031
Step 2	.172	15.938***			
Additive counterfactual			.304	4.503***	.110
Subtractive counterfactual			.718	3.221**	.056

Note: Inc. R^2: increment in variance accounted for; β: unstandardized regression coefficient; sr^2: squared semi-partial correlation.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

scores, $F(2, 76) = 14.23$, $P < .001$, with each variable contributing uniquely. The final equation accounted for 58% of the variance in theory of mind scores. The unstandardized beta coefficients for both upward and downward counterfactuals were significant ($P < .05$). The production of both upward and downward counterfactual accounted for unique variance in theory of mind scores beyond that of age and language.

The second analysis examined counterfactual structure (additive vs. subtractive). In the first step, age and language were entered and the results were identical to those reported above. The numbers of additive and subtractive counterfactuals generated were entered in the second step. These variables accounted for an additional 17% of the variance in theory of mind scores, $F(2, 76) = 15.94$, $P < .001$, with each variable contributing uniquely. The final equation accounted for 59% of the variance in theory of mind scores. The unstandardized beta coefficients for both additive and subtractive counterfactuals were significant ($P < .01$), indicating that the production of both types of counterfactuals accounted for unique variance in theory of mind scores beyond that of age and language.

5.3.3. *Age comparisons*

Given this was the first study to examine antecedent counterfactuals across the 3- to 5-year age range, analyses were conducted to examine age patterns in the generation of different types of counterfactual statements among 3-, 4-, and 5-year-olds. In the complete sample, three children were not yet 3 years of age and two were 6 years of age. For the purposes of the age analyses these children were excluded, $N = 76$. Descriptive statistics are reported in Table 4.

5.3.3.1. Theory of mind and counterfactual performance. A MANOVA was conducted to examine the pattern of age effects for both theory of mind and antecedent counterfactual performance. There was a significant effect of age on both the theory of mind, $F(2, 73) = 24.12$, and the antecedent counterfactual, $F(2, 73) = 9.82$, P's $< .001$, variables. Post hoc analyses indicated that theory of mind and antecedent counterfactual performance increased significantly between each age group, P's $< .05$. These data suggest a similar pattern of development for theory of mind and counterfactual reasoning. When language was entered as a covariate, the age effect remained significant for theory of mind, $F(2, 72) = 4.85$, $P < .05$, but not for antecedent counterfactual, $F(2, 72) = 0.75$, $P > .10$, performance.

5.3.3.2. Number of counterfactual, other, and irrelevant statements. A 3×3 (Age $\times$ Statement) mixed ANOVA examined the frequency with which children generated counterfactual, other, and irrelevant statements in response to the scenarios. Age was a between-subjects variable and Statement was a within-subjects variable. There were main effects of Age, $F(2, 73) = 3.95$, $P < .05$, and Statement, $F(2, 146) = 48.20$, $P < .001$, and a significant interaction, $F(4, 146) = 8.04$, $P < .001$. A series of paired t-tests was used to examine the interaction. The number of counterfactual statements and other statements generated by both 3- and 4-year-olds did not differ, though each group made significantly fewer irrelevant statements than counterfactual or other statements (P's $< .01$). It is interesting to note, though, that 3-year-olds produced more other than counterfactual statements, whereas 4-year-olds generated more counterfactual than other statements. Five-year-olds generated significantly more counterfactual statements than other statements, and more counterfactual and other statements than irrelevant statements (P's $< .001$). Children of all ages produced extremely few irrelevant statements; in fact, 5-year-olds did not produce such statements ($M = 0$). Thus, even the youngest children were able to focus upon the stories and generate responses relevant to the task.

The analysis was repeated with language as a covariate. There was a main effect of Statement, $F(2, 71) = 8.77$, $P < .001$. The main effect of Age, $F(2, 72) = 1.01$, and the interaction, $F(4, 144) = 1.14$, were not significant, P's $> .10$. Children produced more counterfactual than other statements, and more other than irrelevant statements. This analysis indicates that the age effects in the previous analysis were accounted for by improvements in language across the preschool years.

5.3.3.3. Number and types of counterfactuals. Two 2×3 mixed ANOVA's were conducted to examine differences between the age groups in types of counterfactuals generated. The first 2×3 (Direction $\times$ Age) mixed ANOVA was conducted with Direction (upward and downward) as a within-subjects factor and Age as a between-subjects factor. There was neither a main effect of Direction, $F(1, 73) = 0.51$, $P > .10$, nor an interaction, $F(2, 73) = 2.04$, $P > .10$, but there was a significant main effect of Age, $F(2, 73) = 9.83$, $P < .001$. Three-year-olds generated significantly fewer counterfactual statements than 4- or 5-year-olds, and 4-year-olds generated fewer counterfactual statements than 5-year-olds, regardless of direction (see Table 4). When language was included as a covariate, none of the effects were significant (P's $> .10$).

The second 2×3 mixed ANOVA was conducted with Structure (additive and subtractive) as a within-subjects factor and Age as a between-subjects factor. There were significant main effects of Structure, $F(1, 73) = 89.41$, $P < .001$, and of Age, $F(2, 73) = 9.83$, $P < .001$. There also was a significant interaction, $F(2, 73) = 6.39$, $P < .01$. The interaction was examined with two ANOVA's with additive and subtractive counterfactuals as the dependent variables. The effect for additive counterfactuals was significant, $F(2, 73) = 8.73$, $P < .001$. A Tukey's HSD indicated that 3-year-olds generated significantly fewer additive counterfactuals than the 4- and 5-year-olds, and the 4-year-olds generated fewer than the 5-year-olds. There was not a significant effect for subtractive counterfactuals, $F(2, 73) = 1.90$, $P > .10$. Thus, children of all ages generated relatively few subtractive counterfactuals (see Table 4). When the 2×3 ANOVA was repeated with language as a covariate, however, none of the effects were significant.

5.4. Discussion

A primary purpose of the present study was to explore the degree to which counterfactual thinking skills account for individual differences in theory of mind performance using antecedent counterfactual tasks. Antecedent counterfactual performance accounted for 16% of the unique variance in theory of mind scores beyond age and language. Moreover, this effect generalized to the different types of counterfactual statements in that children who performed better on theory of mind tasks were able to generate more specific counterfactual thoughts in terms of direction and structure. In terms of direction, the ability to generate upward and downward counterfactuals accounted for approximately 4.5% of unique variance in theory of mind scores, an amount similar to that accounted for uniquely by language (5.1%) and age (3.1%). Similarly, the ability to generate additive and subtractive counterfactuals spontaneously accounted for significant amounts of unique variance in theory of mind scores (11 and 5.6%, respectively).

In spite of the different assessments of counterfactual reasoning, the present findings correspond to those of Riggs et al. (1998) who found that preschoolers' consequent counterfactual thinking involving physical states predicted their theory of mind performance. The findings of the present study and Riggs et al., taken together, suggest that individual differences in children's performance on theory of mind tasks are related to the ability to consider alternative consequences and alternative antecedents.

Other important findings from this study involve children's age. Consistent with previous research (Harris et al., 1996; Riggs et al., 1998), children as young as 3 years were able to generate counterfactuals. Certainly though, this ability improves with age. Across age groups, similar patterns of the development of mental state understanding and counterfactual reasoning emerged. With regard to both aspects of social cognition, performance increased significantly between 3 and 4 years of age, and less so between 4 and 5 years of age.

Similar to adults, children were able to generate both upward and downward counterfactuals when prompted to do so. Young children generated alternatives that were both better and worse than reality. As noted in the results, this ability improved with age. The number of additive counterfactuals generated also increased incrementally with each age, but all age groups produced few subtractive counterfactuals.

An important finding, though, regarding the age effects and antecedent counterfactual performance was that the effects were no longer significant when language was included as a covariate. Two possible explanations are offered. First, it is plausible that such findings indicate the linguistic demands of the task. A second explanation is that there is an intricate relationship between linguistic sophistication and counterfactual reasoning. These ideas will be discussed further in Section 7.

6. Study 2

Study 1 indicated that children's abilities to generate antecedent counterfactual statements accounted for significant variance in theory of mind performance. Consideration of the present findings and those of Riggs et al. (1998) suggests that children's performance on theory of mind tasks is related to their ability to consider alternative consequences as well as alternative antecedents. The first purpose of Study 2 was to examine theory of mind performance and each type of counterfactual measure (antecedent and consequent tasks) within a single study to address this suggestion. Theory of mind performance was expected to be related to counterfactual performance on both tasks. Second, this design enabled an examination of the relationship between performances on antecedent and consequent measures of counterfactual reasoning to explore similarities between the two tasks. Given that both tasks required children to consider what *could* have happened differently, performances on each type of task were expected to be related.

As in Study 1, performances of 3-, 4-, and 5-year-old children were compared. Also, the types of counterfactual statements generated were examined.

6.1. Method

6.1.1. Participants

Participants were 103 three-, four-, and five-year-old children from a small, rural city: 35 three-year-olds (17 girls, 18 boys; mean age of 40 months; range of 33–47 months); 38 four-year-olds (15 girls, 23 boys; mean age of 53 months; range of 48–59 months); and, 30 five-year-olds (10 girls, 20 boys; mean age of 68 months; range of 60–76 months). Children were recruited either through their preschools or through their parents who were enrolled in introductory psychology courses. Parents who were students received course credit for allowing their children to participate in the study. None of the participants from Study 1 participated in Study 2.

6.1.2. Measures

In addition to the language, theory of mind, and antecedent counterfactual tasks used in Study 1, a set of consequent counterfactual tasks was used in the present study. These tasks were based upon the work of Riggs et al. (1998). For each of these counterfactual tasks, children were told a story about a character and asked to consider an alternative scenario. For example, children were told the following story: Peter is in his house, but Peter isn't feeling very well. So he goes to bed. The phone rings and the man from the Post Office asks Peter to come and help put out a fire. Peter gets out of bed and goes to the Post Office.

Then the children were asked, “If there had not been a fire, where would Peter be?” The other scenarios involved a child painting a picture in his/her yard, a child playing with a ball before school, and a child packing his/her lunch. The character in each story matched the sex of the child. Children received a score ranging from 0 to 4 (1 point for each correct response). The antecedent counterfactual tasks were coded in the same manner as in Study 1. Interrater reliability was high with a Cohen’s kappa of .99.

6.1.3. Procedure

Children were tested individually on two separate occasions in a quiet part of their school. During one 10- to 20-min session children received the language measure and during a second 15- to 20-min session they completed theory of mind tasks and both counterfactual measures. As with Study 1, theory of mind tasks consistently preceded the counterfactual reasoning task, but the order of the two counterfactual tasks was counterbalanced. A different research assistant administered the tasks in the first session and those in the second session to reduce any effects of familiarity with the experimenter. The research assistant recorded each child’s responses during the session. Sessions were separated by 1–48 ($M = 7.73$) days.

6.2. Results

6.2.1. Preliminary analyses

Preliminary analyses indicated that the same patterns of relations among variables emerged in Study 2 as in Study 1. A principal components analysis used to analyze the correlations among the five theory of mind tasks yielded one component with an eigenvalue greater than one (3.03) and loadings ranging between 0.73 and 0.83. Intercorrelations are presented in Table 2.[2] An additional principal components analysis was conducted to analyze the partial correlations among the five tasks controlling for the effects of age and language. This analysis yielded consistent results with one component with an eigenvalue greater than one (2.28) and loadings ranging between 0.64 and 0.77. Internal consistency of the five-item scale was 0.80. Given the consistent principal components analyses and the acceptable level of internal consistency, the sum of children’s scores across tasks constituted a composite theory of mind score from 0 to 7 in subsequent analyses.

The effects of sex and task order were not significant, thus these variables were not considered in subsequent analyses. As expected, language comprehension scores were related to children’s performance on theory of mind, $r(102) = .65$, $P < .01$, and each of the counterfactual reasoning tasks [r’s$(102) = .50, .64$, P’s $< .01$, on the consequent and antecedent tasks, respectively]. Similarly, age was related to performance on each task [$r(102) = .64$ on theory of mind, $r(102) = .35$ on the consequent task, and $r(102) = .58$ on the antecedent task, P’s $< .001$]. Furthermore, theory of mind performance was related to performance on each of the counterfactual tasks [$r(102) = .49$ and .53, on the consequent and antecedent tasks, respectively], and performance on each of the counterfactual tasks was related, $r(102) = .53$, all P’s $< .001$. There were no missing data. Descriptive statistics are presented in Table 7.

[2] Individual task score data were missing for six participants, thus the intertask correlations were conducted with $N = 97$. Composite scores were available for all 103 participants and were used in subsequent analyses.

Table 7
Mean and (standard deviation) language, theory of mind, and antecedent counterfactual reasoning in Study 2

	Age			Total[a] ($N = 90$)	Complete sample[b] ($N = 103$)
	3-year-olds ($n = 28$)	4-year-olds ($n = 38$)	5-year-olds ($n = 24$)		
Language	34.32 (14.52)	54.26 (15.46)	79.58 (13.55)	54.81 (22.55)	54.21 (23.94)
Theory of mind performance	1.36 (1.85)	3.39 (2.26)	5.21 (1.67)	3.24 (2.46)	3.36 (2.51)
Consequent counterfactual reasoning	1.57 (1.07)	2.00 (1.27)	2.75 (1.29)	2.01 (1.29)	2.11 (1.26)
Antecedent counterfactual reasoning task					
Counterfactuals	2.14 (1.90)	2.76 (2.07)	6.17(3.13)	3.48 (2.85)	3.62 (3.19)
Upward	1.00 (1.28)	1.53 (1.11)	3.13 (1.60)	1.79 (1.54)	1.82 (1.64)
Downward	1.14 (1.21)	1.24 (1.22)	2.92 (1.91)	1.66 (1.61)	1.78 (1.83)
Additive	1.79 (1.55)	2.32 (1.82)	5.17 (2.79)	2.91 (2.46)	3.05 (2.78)
Subtractive	0.36 (0.68)	0.45 (0.76)	1.00 (0.98)	0.57 (0.84)	0.57 (0.83)
Other	1.46 (1.11)	1.47 (1.33)	0.92 (1.10)	1.32 (1.22)	1.26 (1.19)
Irrelevant	0.54 (0.92)	0.45 (1.25)	0.04 (0.20)	0.37 (0.98)	0.38 (0.95)

[a] For the analyses of age, only the data of children between 36 and 60 months of age were included.
[b] Complete sample includes all children, ranging in age from 33 to 76 months, who participated in the study.

6.2.2. Overview of critical analyses

As in Study 1, both hierarchical regressions and ANOVAs were conducted to address the hypotheses. These analyses were conducted in the same manner as in Study 1.

6.2.3. Theory of mind and counterfactual reasoning performance

To examine further the relationship between theory of mind performance and performance on each type of counterfactual task, a hierarchical regression was performed (see Table 8). Age and language were entered in the first step with theory of mind scores as the dependent

Table 8
Hierarchical regression analysis of antecedent counterfactuals as a predictor of theory of mind scores: Study 2

Step	Inc. R^2	F-change	B	t-value	sr^2
Step 1	.457	42.072***			
Age (months)			.072	2.718**	.040
Language			.040	3.101**	.052
Step 2	.016	3.048+			
Antecedent counterfactuals			.132	1.746+	.016
Step 3	.031	6.112*			
Consequent counterfactuals			.431	2.472*	.031

Note: Inc. R^2: increment in variance accounted for; B: unstandardized regression coefficient; sr^2: squared semi-partial correlation.

* $P < .05$.
** $P < .01$.
*** $P < .001$.
+ $P < .10$.

variable. These variables accounted for 46% of the variance in theory of mind scores, $F(2, 100) = 42.07$, $P < .001$, with each variable contributing uniquely. The unstandardized beta coefficients for both age and language were significant at $P < .01$. In order to compare the results from Study 2 to those of Study 1, the antecedent counterfactual variable was entered on the second step, producing an R^2 change of 2%, $F(1, 99) = 3.05$, $P = .08$. The consequent counterfactual variable was entered on the third, and final step, accounting for an additional 3% of the variance in theory of mind scores, $F(1, 98) = 6.11$, $P < .05$. The final regression equation accounted for 50% of the variance in theory of mind scores, $F(4, 102) = 24.91$, $P < .001$. The beta coefficient for age (.07) and consequent counterfactuals (.43) remained significant, $P < .05$, in the final equation.

6.2.4. Theory of mind performance and generation of types of counterfactuals

As in Study 1, the relationship between level of theory of mind performance and generation of each type of counterfactual on the antecedent task was explored with a series of regressions with theory of mind as the dependent variable (see Table 9). The first analysis examined counterfactual direction (upward vs. downward). In the first step, age and language were entered and the results were identical to those reported above. The number of upward and downward counterfactuals generated were entered in the second step. These variables accounted for an additional 3% of the variance in theory of mind scores, approaching a significant proportion of the variance, $F(2, 98) = 2.53$, $P = .09$. Only upward counterfactuals contributed uniquely to theory of mind performance. The final equation accounted

Table 9
Hierarchical regression analysis of types of counterfactuals as predictors of theory of mind scores: Study 2

Step	Inc. R^2	F-change	B	t-value	sr^2
Direction					
Step 1	.457	42.072***			
Age (months)			.072	2.718**	.040
Language			.040	3.101**	.052
Step 2	.027	2.531+			
Downward			.348	2.024*	.022
Upward			−.026	−0.192	.000
Structure					
Step 1	.457	42.072***			
Age (months)			.072	2.718**	.040
Language			.040	3.101**	.052
Step 2	.033	3.207*			
Additive			.072	0.882	.004
Subtractive			.587	2.245**	.026

Note: Inc. R^2: increment in variance accounted for; B: unstandardized regression coefficient; sr^2: squared semi-partial correlation.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

\+ $P < .10$.

for 70% of the variance in theory of mind scores. The unstandardized beta coefficients for age (.06), language (.02) and upward counterfactuals (.35) were significant ($P < .05$). In the final equation, production of upward counterfactuals accounted for unique variance in theory of mind scores beyond that of age and language.

The second analysis examined counterfactual structure (additive vs. subtractive). In the first step, age and language were entered and the results were identical to those reported above. The number of additive and subtractive counterfactuals generated were entered in the second step. These variables accounted for an additional 3% of the variance in theory of mind scores, $F(2, 98) = 3.21$, $P < .05$. Only subtractive counterfactuals contributed uniquely to theory of mind performance. The final equation accounted for 70% of the variance in theory of mind scores, $F(4, 102) = 23.57$, $P < .001$. The unstandardized beta coefficients for age (.07) and subtractive counterfactuals (.59) were significant ($P < .05$), indicating that age and the production of subtractive counterfactuals accounted for unique variance in theory of mind scores beyond that of language and number of additive counterfactuals generated.

6.2.5. Age comparisons

As in Study 1, age patterns in the generation of different types of counterfactuals were examined. In the complete sample, seven children were not yet 3 years of age and six were 6 years of age. For the purposes of the age analyses these children were excluded, $N = 90$. The analyses were conducted first without consideration of language, and then they were conducted with language as a covariate. Descriptive statistics are presented in Table 5.

6.2.5.1. Theory of mind and counterfactual reasoning performance. A MANOVA was conducted to compare theory of mind performance and counterfactual thinking among 3-, 4-, and 5-year-olds. There was a significant effect of age on theory of mind understanding, $F(2, 87) = 24.32$, $P < .001$, and both of the counterfactual reasoning tasks, $F(2, 87) = 6.14, 21.93$, P's $< .01$, for the consequent and antecedent tasks, respectively. A Tukey HSD analysis indicated that theory of mind performance of each age group differed significantly. On both of the counterfactual tasks, 3- and 4-year-olds performed similarly, and 5-year-olds performed better than both of the younger groups. Means are presented in Table 6. These data suggest some similarities in the developmental paths of theory of mind understanding and counterfactual thinking (see Table 5).

To explore the importance of language in social cognitive development, the MANOVA was repeated with language as a covariate. The effect of age on theory of mind, $F(2, 99) = 3.41$, $P < .05$, and on antecedent counterfactual performance, $F(2, 99) = 4.97$, $P < .01$, remained significant. When language variance was controlled, however, the effect of age on consequent counterfactual performance was not significant, $F(2, 99) = 0.40$, $P > .10$.

6.2.5.2. Number of counterfactual, other, and irrelevant statements on the antecedent task. A 3×3 (Age $\times$ Statement) mixed ANOVA examined the frequency with which children made counterfactual, other, and irrelevant statements in response to the antecedent scenarios. Age was a between-subjects variable and Statement was a within-subjects variable. There were main effects of Age, $F(2, 87) = 18.14$, $P < .001$, and Statement, $F(2, 174) = 76.98$, $P < .001$, and a significant interaction, $F(4, 174) = 15.49$, $P < .001$. A series of paired t-tests was used to examine the interaction. Three-year-olds generated as many other statements as counterfactual statements, but they produced fewer irrelevant statements than responses of the other types (P's $< .01$). Both 4- and 5-year-olds generated more counterfactual statements than other or irrelevant statements, and fewer irrelevant than other statements (P's $< .01$, see Table 5), though mean differences were greater for 5-year-olds. Children of all ages produced few irrelevant statements; in particular, 5-year-olds generated extremely few irrelevant statements ($M = .04$). Thus, even the youngest children were able to focus upon the stories and generate statements relevant to the task. When language was entered into the analysis as a covariate, the Age $\times$ Statement interaction remained significant, $F(4, 172) = 2.52$, $P < .05$, though the main effects of Age, $F(2, 86) = 2.64$, $P = .08$, and of Statement, $F(2, 172) = 7.32$, $P = .11$, only approached significance.

6.2.5.3. Number and types of counterfactuals on the antecedent task. Two 2×3 mixed ANOVA's were conducted to examine differences between the age groups in types of counterfactuals generated on the antecedent task. The first 2×3 (Direction $\times$ Age) mixed ANOVA was conducted with Direction (upward and downward) as a within-subjects factor and Age as a between-subjects factor. There was neither a main effect of Direction, $F(1, 87) = 0.63$, $P > .10$, nor an interaction, $F(2, 87) = 0.83$, $P > .10$, but there was a significant main effect of Age, $F(2, 87) = 20.35$, $P < .001$. As indicated in the previous analysis, 5-year-olds generated significantly more counterfactual statements than 3- and 4-year-olds, regardless of direction. The 3- and 4-year-olds performed similarly (see Table 5). The pattern of results did not change when language was entered as a covariate.

The second 2×3 mixed ANOVA was conducted with Structure (additive and subtractive) as a within-subjects factor and Age as a between-subjects factor. There were significant main effects of Structure, $F(1, 87) = 128.92$, $P < .001$, and of Age, $F(2, 87) = 21.93$, $P < .001$. There also was a significant interaction, $F(2, 87) = 13.41$, $P < .001$. Two ANOVA's were conducted to examine the interaction. The effects for additive, $F(2, 87) = 20.31$, $P < .001$, and for subtractive, $F(2, 87) = 4.89$, $P < .01$, counterfactuals were significant. For both additive and subtractive counterfactuals, Tukey analyses indicated that 5-year-olds generated more counterfactuals than did 3- and 4-year-olds (P's $< .01$); performance of the 3- and 4-year-olds did not differ. All children produced relatively few subtractive counterfactuals (see Table 5). When language was entered as a covariate, the main effect of Age, $F(2.86) = 3.66$, $P < .05$, and the interaction, $F(2, 86) = 3.57$, $P < .05$, remained significant, though the main effect of Structure, $F(1, 86) = 2.06$, $P > .10$, did not.

6.3. Discussion

When antecedent counterfactual performance was entered as the second step in the regression, it accounted for 2% of the variance in theory of mind performance ($P = .08$) beyond that accounted for by age and language. Consequent counterfactual performance accounted for an additional 3% of the variance ($P < .05$) beyond all of the other variables. The second regression, however, indicated that antecedent counterfactual performance did not account for unique variance beyond that accounted for by consequent counterfactual performance. The findings suggest that counterfactual reasoning accounts for limited variance in theory of mind performance.

The results of the regressions are consistent with the correlation analyses in indicating overlap between the two types of counterfactual reasoning tasks. Children's performances on each type of counterfactual task were highly correlated. Children who are able to understand counterfactual situations can speculate how a different antecedent would change an event and can generate such alternative antecedents independently.

The ability to generate different types of counterfactuals accounted for theory of mind performance beyond that of age and language. Age accounted for 4% and language accounted for 5.2% of unique variance in theory of mind scores. Upward and subtractive counterfactual thinking contributed uniquely to the prediction of theory of mind performance (2.2 and 2.6%, respectively). The ability to generate downward and additive counterfactuals, however, was not associated with theory of mind performance. Yet, these data suggest that children's ability to think flexibly about the association between antecedents and consequences, both in terms of counterfactual direction and structure, is related to their ability to take another's perspective as assessed in theory of mind tasks.

Children as young as 3 years of age were able to generate alternative antecedents as well as consequences. Such abilities, though, improved across age groups. When age was considered as a control variable, the age effects remained significant for the antecedent task, but not the consequent task.

With regard to the specific types of counterfactuals, children who were able to generate counterfactual statements could generate both upward and downward counterfactuals equally well. Overall, though, children generated fewer subtractive than additive counterfactuals. Children's difficulties with generating subtractive counterfactuals was highlighted by the finding that though 5-year-olds generated more counterfactuals of each type than did 3- and 4-year-olds, differences were much less pronounced for subtractive counterfactuals.

Between 3 and 5 years of age, both theory of mind performance and counterfactual reasoning improved. Theory of mind performance increased between each age group. Counterfactual reasoning of both types improved across these age groups, though the 3- and 4-year-olds' performances did not differ significantly. Inclusion of languge as a control variable eliminated the age effects for the consequent task, but not for the theory of mind or antecedent tasks.

7. General discussion

An association between theory of mind performance and counterfactual reasoning was indicated by high intercorrelations among theory of mind, antecedent counterfactual thinking, and consequent counterfactual thinking, and similarities in developmental patterns. The preschool years are a significant time for changes in each type of reasoning.

Counterfactual thinking accounted for 3–16% of the variance in theory of mind performance beyond age and language. Riggs et al. (1998) found that consequent counterfactual performance accounted for approximately 25% of the variance in theory of mind performance of 3- to 4-year-old children. Differences between their study and the present ones include a different age range (Riggs et al. included 3- to 4-year-olds; the present study included 3- to 5-year-olds), range of theory of mind tasks (Riggs et al. included two change of location tasks; the present study included change of location, deception, and unexpected change tasks), and, thus, different ranges of theory of mind scores (0–2; 0–7). Moreover, Riggs et al. included the consequent counterfactual tasks with a range of 0–4, and the present study included their tasks as well as antecedent counterfactual tasks with an open range. Any of these factors could have accounted for the differences in variance accounted for.

The importance of the age ranges could be considered with the present data sets. In fact, when only children under 5 years of age were included, counterfactual thinking accounted for 20% of the variance in theory of mind performance in Study 1, and 5% in Study 2. Thus, the percentages increased slightly when the age range was limited to the younger age groups. Such findings could indicate the importance of counterfactual reasoning abilities for early theory of mind performance. Considered together, research thus far on counterfactual reasoning and theory of mind performance suggests that counterfactual reasoning skills, both antecedent and consequent counterfactual reasoning, account for individual differences in theory of mind performance among normal (present study; Riggs et al., 1998) and autistic (Peterson & Bowler, 2000) children.

Much of the variance in theory of mind performance was left unaccounted for, though, suggesting the importance of consideration of differences between these two types of skills. Perhaps the most critical difference between theory of mind and counterfactual reasoning tasks used thus far is that theory of mind tasks involve a reference to mental states. As a defining characteristic, theory of mind tasks are about one’s own or another’s thought or belief. In contrast, counterfactual tasks have focused on physical states: where an object would be, what would have prevented the floor from getting dirty. It is logical that the mental state element involved in theory of mind tasks is unaccounted for by counterfactual reasoning in a general sense. Perhaps a stronger relationship would be found between counterfactual reasoning tasks that involve reference to social interaction and/or mental states and theory of mind performance than was found here. Future research should examine this possibility.

The second study indicated that overall, antecedent counterfactual performance did not account for variance in theory of mind scores beyond age, language, and consequent counterfactual performance. Both the antecedent and the consequent tasks required children to ignore current “reality” to consider how an event could have been different. In some ways, the format of the consequent task parallels that of theory of mind tasks more closely in that the correct answer is provided within the context of the story. For example, in the Maxi task children are told where Maxi put the chocolate and on the consequent task children are told where the character or object was prior to the critical event (Peter was in bed when he received the phone call). This is not to say that children are “given” the answer, but perhaps the fact that the antecedent task requires children to generate alternative antecedents that they had not been explicitly told accounted for the difference in results. It should be noted, though, that antecedent counterfactual performance accounted for much more variance in Study 1 than in Study 2. Of course, relationships among theory of mind, antecedent, and consequent performance were not examined in Study 1.

The reason for the discrepancy in the amount of variance accounted for between the present two studies is unclear. Indeed 3–16% variance is a broad range. Examination of the descriptive statistics for age, language, theory of mind, and antecedent counterfactuals in both studies indicates high degree of similarity across studies. The only procedural difference was the inclusion of the consequent counterfactual tasks in Study 2, which increased the duration of the second session by approximately 5 min. It is not clear why, nor is it likely that, this difference impacted the results. Another difference was that age and language accounted for more variance in theory of mind scores in Study 2 than in Study 1, thus leaving less residual variance to explain. Also, the antecedent task scores correlated more highly with age and language in Study 2 than in Study 1. The overlap among these variables could have led to the differential results. Psychological variables are complex; accounting for even 3% of the variance in a skill is worthy of mention. This point is emphasized further by the fact that age and language each accounted for between 3.1 and 5.2% of unique variance in theory of mind performance across studies.

A key finding was that types of counterfactuals generated accounted for unique variance in theory of mind performance. In both studies, the ability to generate counterfactual statements that differed in both direction and structure proved to be important predictors of theory of mind performance. Upward (4.5%), downward (4.7%), additive (11%), and subtractive (5.6%) counterfactual generation accounted for unique variance in Study 1. In Study 2, additive (2.2%) and subtractive (2.6%) counterfactual generation accounted for unique variance, although less variance than was observed in Study 1. Again, across the two studies the amount of variance accounted for by type of counterfactuals generated was quite variable, 2–11%. Upward and subtractive counterfactuals were the two types of counterfactuals that consistently predicted theory of mind performance. There is evidence with adults that could suggest these two forms of counterfactual thinking might be indicative of theory of mind performance. Upward counterfactual thinking has been referred to as the “default” form of counterfactual thinking, meaning it is the most common form of counterfactual thinking (Roese, 1994). Upward counterfactual thinking might capture children’s basic ability to generate and maintain in memory an outcome that differs from reality. In contrast, adults spend more time processing subtractive counterfactuals than any other type of counterfactual, presumably because they require more cognitive resources (Turley-Ames & Whitfield, 2000). This type of thinking might capture how sophisticated children are in their ability to consider different alternatives. This interpretation might complement Peterson and Riggs’ (1999) notion of modified derivation. In particular, subtractive counterfactuals require children to remove and ignore some aspect of an event in order to consider how the event might have turned out differently. These and other explanations should be examined further in future research.

Present results also indicated the importance of language for theory of mind understanding and counterfactual reasoning. Across studies some, though not all, of the effects of age on counterfactual reasoning were eliminated when language was included as a control variable. Nelson (1996) has argued for the importance of language in social cognitive development. Rather than perceiving language as a nuisance variable, she argues that language is a medium through which social cognitive development occurs. The importance of a linguistic environment that includes mental terms for theory of mind understanding has been demonstrated with deaf populations. Prelingual deaf children living in homes without native signers demonstrate delays in theory of mind understanding whereas those living with native signers do not (Peterson & Siegal, 1995, 1999; Russell et al., 1998) perhaps because the former group is exposed to fewer conversations about mental states (Meadow, Greenberg, Erting, & Carmichael, 1981). Such findings implicate language and exposure to mental terms for knowledge of the mental world. Mental states and consideration of alternative events only can be accessed linguistically. Perhaps one of the central changes across the preschool years is in children's abilities to speak about mental concepts. As children's linguistic skills improve, they are better able to engage in discussions about their own and others' feelings as well as to consider how situations could have been different.

Given the above arguments and the nature of the language measure used in the present research, it is perhaps not surprising that language accounted for much of the relationship between counterfactual thinking and theory of mind performance. To perform well on the counterfactual tasks children had to consider mentally how an event could have been different as well as express those ideas linguistically. Linguistic skills are likely involved in both aspects of counterfactual reasoning (see Riggs et al., 1998; de Villiers & de Villiers, 2000). Compared to previous work (e.g, Riggs et al., 1998), a more global language assessment (i.e., word comprehension, morphology, and sentence comprehension) was used in the present study. Thus, this measure assessed many of the language skills thought to be necessary for counterfactual reasoning. This might be especially the case for the antecedent counterfactual tasks given the open-ended nature of the task. Children could earn credit for their counterfactual thoughts when they did not express them in complete sentences, but this task was more linguistically demanding than the consequent task on which correct answers were the identification of a single object or location. Thus, the results reflect the complex nature of the relationships among language, counterfactual reasoning, and theory of mind understanding.

The present study also examined whether counterfactual statements generated by preschool aged children parallel those produced by adults. Children who were able to generate counterfactual statements on the antecedent task were able to produce upward and downward counterfactuals equally well. This is not surprising given that two scenarios were designed to prompt upward and two were designed to prompt downward counterfactuals. In addition, like adults, preschoolers generated fewer subtractive counterfactuals. Across studies, age differences in counterfactual performance were either nonexistent (Study 1) or minimal (Study 2) with regard to subtractive counterfactuals. In both studies, preschool aged children produced relatively few subtractive counterfactuals, suggesting that there is something different about generating subtractive versus additive counterfactual statements. The adult literature indicates that subtractive counterfactuals are more effortful (Turley-Ames & Whitfield, 2000). Future research should explore this explanation with children.

One interpretation of the present findings is that children acquire increased flexibility in their thinking across the preschool years and beyond.[3] As early as 1.5 years children demonstrate what might be the first indication of counterfactual thinking, pretend play. Pretend play is similar to other types of counterfactual thinking in that it involves consideration of events that do not parallel current reality (Amsel & Smalley, 2000). Differences also can be seen, though. One suggestion is that pretense does not involve conflict, whether between real and pretend content (Peterson & Riggs, 1999) or between temporal sequences (Perner, 2000). Thus, though pretense involves consideration of a counterfactual, it is perhaps a simpler, yet important, form of counterfactual thinking. Between 3 and 5 years of age children develop skills to consider their own and others' thoughts and feelings and

[3] Appreciation to an anonymous reviewer for suggesting the idea of cognitive flexibility across the preschool years.

how sequences of events could be different. As children acquire linguistic sophistication, they are able to manipulate events mentally. They can consider alternatives to reality and mentally consider different antecedents and consequences. Moreover, across this age period they increase their repertoire of antecedents that could lead to specified outcomes. This is evident in the present data set in that older children were more likely to generate both additive and subtractive counterfactuals spontaneously. Increasing skill with counterfactual reasoning likely continues into adulthood with improved skills in generating different types of counterfactual statements. Most likely such improvements across age are related to changes in other areas of cognitive functioning (i.e., working memory, inhibitory control).

Regression analyses suggested that counterfactual thinking predicts theory of mind performance and such analyses reflect a directional effect. They are, however, correlational analyses, meaning they do not unequivocally indicate a causal relationship between counterfactual thinking and theory of mind performance; theory of mind understanding could precede counterfactual reasoning. The former seems to make more intuitive sense, though. The ability to consider alternative antecedents and consequences seems to underlie both counterfactual and theory of mind performance. The correlations between counterfactual thinking and theory of mind indicate a high degree of overlap, but not redundancy. As suggested earlier, theory of mind performance indicates the ability to apply counterfactuals to mental states, whereas most counterfactual assessments focus on concrete, physical situations. It seems logical that the ability to think counterfactually, in general, would precede the ability to apply counterfactuals to more abstract concepts, like mental states. Longitudinal research is needed to clarify the direction of effect.

A critique of the present study might be that the antecedent counterfactual tasks were particularly demanding linguistically. Data indicated, though, children of all ages made few irrelevant statements. Thus, even the youngest children were able to attend to the scenarios and respond to the questions in a relevant manner. Such findings increase the likelihood that the measures accurately assessed children's counterfactual reasoning skills.

The present study examined whether 3- to 5-year-old children could produce antecedent counterfactual statements; thus, the tasks were designed to prompt such reasoning. In future research, the types of counterfactual statements that children produce spontaneously needs to be explored. With the present design, counterfactual statements were prompted in terms of direction, but not structure. Thus, the current findings do suggest that children spontaneously produce more additive than subtractive counterfactuals. A next step is to provide less guidance to determine whether such young children, like adults (Sanna & Turley, 1996), generate counterfactual statements spontaneously, and if so, whether they generate additive and subtractive statements equally. The importance of such factors as working memory (Davis & Pratt, 1995; Gordon & Olson, 1998) and inhibitory control (e.g., Carlson & Moses, 2001; Carlson et al., 1998; Hughes, 1998; Leslie & Polizzi, 1998) has been implicated with regard to theory of mind development. The degree to which such skills explain the relationship between theory of mind and counterfactual reasoning, or children's counterfactual skills independent of theory of mind should be explored.

The present studies have extended current work on children's counterfactual thinking and theory of mind understanding by incorporating antecedent counterfactual tasks. Children responded to open-ended questions that enabled an analysis of different aspects of counterfactual thinking (i.e., direction and structure) that corresponded to counterfactual research with adult populations. Between 3 and 5 years of age, children become capable of reasoning both about relations between thoughts and behavior and about how altering antecedents and consequences could change an event. It is likely that theory of mind performance and counterfactual thinking provide an important foundation for young children's abilities to function effectively within their social contexts. Future exploration of these aspects of social cognition will enlighten changes in young children's social cognitive development.

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