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Conflict Inhibitory Control Facilitates Pretense Quality in Young Preschoolers

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Abstract

The present research explores the role of inhibitory control in young preschoolers' pretense ability using an ego depletion paradigm. In Experiment 1 ($N = 56$), children's pretense ability was assessed either before or after participating in conflict inhibitory control or control tasks, and in Experiment 2 ($N = 36$), pretense ability was measured after children engaged in either conflict or delay inhibitory control tasks. In both experiments, pretense scores were significantly higher only after engaging in conflict inhibitory control tasks. Further, pretense scores were positively correlated with inhibitory control scores when conflict inhibitory control was *not* experienced first. This pattern of results suggests that inhibitory control may underlie pretense, and conflict inhibitory control can boost the quality of children's subsequent pretending.

Keywords

pretense; inhibitory control; preschool

The ability to pretend is an important and uniquely human component of typical cognitive development. It emerges remarkably early in childhood: by age two, children already can understand another person's pretense and perform object substitutions (Haight & Miller, 1993; Harris & Kavanaugh, 1993). With age, children's pretense becomes more flexible and less tied to reality, and they begin creating imaginary objects and engaging in fantastical situations. Like other symbolic abilities, pretense reliably appears across cultures and without direct instruction from adults or peers (Lillard, 2004). In fact, the lack of spontaneous pretend play early in childhood or an unwillingness to engage in pretense can be an early indication of Autistic Spectrum Disorder (Baird, Charman, Baron-Cohen, Cox, Swettenham, Wheelwright, & Drew, 2000). Although the developmental timeline of overt pretend behavior is well-established, little is known about the cognitive processes that underlie the ability to pretend.

There is reason to expect that inhibitory control (IC) may be one such process. IC is recruited in ignoring distractions and avoiding verbal, physical, and mental prepotent responses (Diamond, 2006). IC emerges near the end of the first year; one early indication is infants' success in Piaget's A-not-B task (Diamond, 1985); to pass this task, infants must

inhibit their first response, which is to reach to the first location a toy was hidden, in order to reach to the correct location. With age, experience, and the development of the prefrontal cortex, children become increasingly able to control their actions and their thoughts. The fact that IC begins to develop shortly before toddlers exhibit their first pretend action is consistent with the hypothesis that IC helps facilitate the ability to pretend.

IC has also been implicated as an important factor in the ability to represent non-realities, most notably in theory of mind tasks (e.g., Carlson, Moses, & Claxton, 2004; Hughes, 1998a, 1998b; Perner & Lang, 1999). Pretense has long been theoretically (Leslie, 1987; Lillard, 1993) and empirically (Taylor & Carlson, 1997) linked to theory of mind understanding. Like pretense, accurate theory of mind understanding requires that children represent both reality and an alternative to reality. In order to solve a false belief problem, like knowing that I will first look for my hat where I left it not where my sister hid it, one has to represent both reality (where the hat is) and an alternative (where I think it is). Likewise, in order to understand my behavior if I pretended to eat soup from my hat, an observer would need to represent both reality (the object is a hat) and an alternative (the object is a bowl). Given the similar cognitive demands of these two abilities, it may be that the same cognitive mechanisms which allow theory of mind understanding are also involved in the ability to pretend.

Because inhibitory control is recruited in such a wide variety of situations, it is often broken down into subtypes; the distinction that is most relevant for the present research is conflict versus delay IC. Conflict IC is specifically used whenever one has to stop a prepotent response in favor of making an atypical response, or respond to a stimulus in a way that is in conflict with how one would usually respond, as in Luria's Hand Game (Luria, Pribram, & Homskaya, 1964) or the Stroop task (Stroop, 1935). In contrast, delay IC tasks require participants to wait before acting, as in go/no-go tasks in which a participant is instructed to wait for a target stimulus before completing a certain behavior.

Conflict IC has been shown to be especially important in theory of mind understanding. Carlson and Moses (2001) found that theory of mind scores were significantly related to both conflict and delay IC scores in 3- and 4-year-olds, even after taking into account the effects of gender, age, and verbal ability. However, conflict IC scores accounted for variance in theory of mind scores above and beyond delay IC scores. The reverse was not the case: delay IC scores did not account for additional variance after conflict IC scores were taken into account. This analysis indicates that although both types of IC are factors in the ability to reason about minds, conflict IC is the more influential factor, a finding which has been replicated and extended several times (e.g., Carlson, Moses, & Breton, 2002; Perner, Lang, & Kloo, 2002).

The present research tests the hypothesis that conflict IC is similarly important in young children's ability to pretend. To do so, an ego depletion paradigm was used. It is becoming increasingly clear that self-control is a limited resource that can be fatigued temporarily by engagement in IC tasks (e.g., Baumeister, Vohs, & Tice, 2007), a phenomenon called ego depletion. After participating in such tasks, adults are less able to control their behavior in a variety of other domains. For example, being depleted can increase stereotyped behavior

(Govorun & Payne, 2006), aggressive behavior (DeWall, Baumeister, Stillman, & Gailliot, 2007), and impulse spending (Vohs & Faber, 2007). To date, this ego depletion effect has mostly been studied in adolescents and adults; however, a recent finding by Lillard and Peterson (2011) hints that young children may also be susceptible. In this study, children who watched a fast-paced, fantastical cartoon subsequently demonstrated lower executive functioning skills than children who watched slower cartoons or no television at all.

If conflict IC is required in pretending, fatiguing children's IC should cause an immediate decline in pretense quality. To test this hypothesis, children's pretense ability was assessed after engaging in a series of conflict IC tasks and compared to pretense scores from children who either completed no tasks or a series of tasks without inhibitory demands before pretending.

Experiment 1

Method

Participants—Fifty-six 3- and young 4-year-old ($M = 3;8$ months, $SD = 4.7$ months, range = $3;0 - 4;5$) children participated in this experiment. Data from three additional children were excluded due to non-compliance. Children were recruited in both a small, Mid-Atlantic city and in an urban area of the Northeast from preschools, a children's museum, and databases of families interested in participating in research. The sample included 27 boys and 29 girls, most of whom were Caucasian. Informed consent was obtained from parents prior to participation, and children were compensated with a prize.

Design and Procedure—Children were tested individually in a quiet location at their preschool, a children's museum, or in a laboratory. All tasks were administered in a single session, which lasted approximately 20–30 minutes. Children were assigned to one of three conditions: conflict IC first ($M = 3;9$ months, $SD = 4.4$ months, range = $3;1 - 4;3$), neutral tasks first ($M = 3;8$ months, $SD = 5.3$ months, range = $3;0 - 4;5$), or pretense first ($M = 3;7$ months, $SD = 4.2$ months, range = $3;0 - 4;0$). In the conflict IC first condition, pretense performance was assessed after participants engaged in the conflict IC battery. The neutral tasks first and pretense first conditions assessed children's pretense ability in a non-depleted state. Children in the neutral tasks first condition completed a modified version of the conflict IC tasks that had all the inhibitory control demands removed. This condition controlled for the possibility that engaging in the conflict IC battery might affect children's pretense for some other reason besides depletion of IC. Lastly, children in the pretense first condition then completed the conflict IC battery second to check whether pretense has an effect on conflict IC performance. Within each battery, task order was counter-balanced. The individual tasks and scoring are described in the following sections.

Conflict Inhibitory Control Measures—Children's conflict IC was tested using four tasks which have been previously demonstrated to be appropriately challenging for young preschoolers (Carlson, 2005): Grass/Snow, Dimensional Change Card Sort, Luria's Hand Game, and Head-to-Toes.

For Grass/Snow (Carlson & Moses, 2001), a yellow mat with one green and one white rectangle (each 6×4 inches) was placed in front of participants so that the rectangles were equidistant from the child. After establishing that s/he knew the color of both grass and snow, participants were instructed to touch green when the experimenter said “snow” and touch white for “grass.” Participants received 12 test trials with no feedback after several practice ones in which corrective feedback was given. Test trials were given in a random order, with the only stipulation being that no one trial type was given more than three times in a row.

The Dimensional Change Card Sort (DCCS) requires children to sort a set of stimuli based on two different dimensions (Frye, Zelazo, & Palfai, 1995). Children were asked to sort six cards with blue circles and six with red stars into two boxes, one labeled with a blue star and one labeled with a red circle. First children were told to sort the cards by color and then by shape. Children were required to correctly answer memory check questions about the rules before both sorts began.

Luria’s Hand Game requires children to first imitate a hand shape the experimenter makes and then make the opposite hand shape as the experimenter (Hughes, 1998b). First, participants practiced making two hand shapes, a fist and a point (all fingers curled with index finger extended). For each trial, the experimenter held her hand behind her back and then moved it in front of her body in one of the two hand shapes. Children were told to copy the experimenter’s hand shape (six total trials, three of each type). Then, children completed six additional trials in which they had to make the opposite hand shape of the experimenter. Before each set of trials, children completed several practice trials with corrective feedback if needed.

The Head-to-Toes task (Cameron, McClelland, Jewkes, Connor, Farris, & Morrison, 2008) is a game in which children have to ignore an experimenter’s direction in order to produce a different action. When the experimenter tells the child “touch your head,” the child has to touch their toes, and vice versa. Again, children answered memory check questions concerning the rules, completed several practice trials with corrective feedback if necessary, and then received 12 test trials in a random order.

Modified Conflict Inhibitory Control Tasks—Each of the conflict IC tasks was changed only to remove the inhibitory control demands. Specifically, children were instructed to make the prepotent response instead of the unnatural response. In the Grass/Snow task, after children were first asked to identify the color of grass and the color of snow, they were instructed to touch green every time the experimenter said “grass” and white every time the experimenter said “snow”. After several practice trials with feedback, children completed 12 test trials with no feedback. Thus, the procedure was identical to the regular conflict IC battery, except that children were instructed to make the natural response.

In the DCCS task, children were again asked to sort the same 12 cards (six blue circles and six red stars) into two boxes, first by color and then by shape. However, the boxes were labeled differently, with a blue circle and a red star instead of a red circle and blue star. Thus, the two sorts were the same and children simply matched the card to the label for both

sorts. The instructions and the procedure were identical to described above. The first six trials of Luria's Hand Game, in which children matched the experimenter's hand shape, were conducted as described previously. Instead of being asked to do the opposite hand shape for the second six trials, the experimenter simply repeated the instructions and procedure of the first six trials again, for a total of 12 imitation trials. In the Head-to-Toes task, children were simply asked to follow the experimenter's instruction to either touch their head or toes. Again, 12 test trials without feedback were given after several practice trials with feedback.

Pretense Measures—The pretense battery was composed of four pretense tasks, given in a counter-balanced order. Following Taylor and Carlson (1997)'s Pretend Actions task, children were asked to demonstrate five pretend actions (comb hair, brush teeth, eat with a spoon, draw a picture, and cut with a knife) without props. For each of the actions, children could either use a body part to stand in for an object or they could create an imaginary object, the latter indicating more advanced symbolic ability (Elder & Pederson, 1978; Boyatzis & Watson, 1993). Children received 1 point for each imaginary object they created.

In the Impersonation Interview, children were asked if they ever pretend to be three different entities: an animal, a different person, and a machine. If they answered affirmatively, they were asked to provide an example and to demonstrate how they pretend (e.g., Sharon & Woolley, 2004). Children received 1 point for providing an example. Then, children were awarded up to 2 points based on how they responded to the experimenter's request to show how they pretend to be each entity. Children who did not pretend got 0 points, children who pretended only briefly or who responded by verbally describing how they pretend got 1 point, and children who showed several pretend actions got 2 points. The possible range of scores was 0 – 9.

In the Telephone task (adapted from Taylor, Cartwright, & Carlson, 1993) children were given a real, but non-functional, cell phone and asked to pretend to call someone. The experimenter only participated in the pretense if invited to by the child (e.g., if the child handed the experimenter the phone and said, "It's for you!"). However, the experimenter would never elaborate the child's pretense. The task ended when the child indicated the phone call was over. Children's pretense was rated on a scale of 0 – 2. No points were given for children who did not call or simply played with the mechanical aspects of the phone (e.g., just pressed buttons). Partial credit, 1 point, was given to children who did a pretend action, but did not elaborate it at all. A prototypical example of this category was a child who held the phone up to his or her ear, but did not say anything. Pretense that followed a script or story received 2 points. For instance, a child might dial numbers, hold the phone up, say hello and goodbye, hang up the phone, and subsequently report who they pretended to call.

The fourth pretense task was a semi-structured play session based on a snack time scenario. The experimenter placed two plastic cups, two plastic bowls, and a pitcher in front of the child and asked the child to, "Show me how we can pretend to have a snack." The experimenter let the child determine the direction of the play, doing whatever the child

asked or imitating the pretend actions of the child when appropriate. For instance, if the child pretended to drink, the experimenter would also pretend to drink. If the child did nothing for approximately 30 seconds or stopped pretending, the experimenter asked if there was anything else they could do to pretend to have a snack. The task ended when the child said there was nothing else. Children received 0–3 points for the snack scenario. Children in the least advanced category (0 points) did nothing or only manipulated the props based on their physical properties (e.g., stacking the props or sorting them by color). Children whose pretense was heavily scaffolded by the experimenter received 1 point. The next level (2 points) consisted of children who did not need many suggestions from the experimenter, but only utilized the props available (i.e., eat, drink, pour). Children who demonstrated the most advanced level (3 points) did not need any prompting from the experimenter, created imaginary objects, and often went beyond the props available (e.g., cleaning up a spill).

Scoring—All sessions were videotaped and double-coded by trained research assistants at separate times (one pair of coders scored two-thirds of the data, another pair scored the remaining one-third); discrepancies were resolved by discussion. Coders were blind to the experiment's hypotheses, but not children's condition. For each conflict IC and modified conflict IC measure, children received one point for each correct response. In order to weight each task equally, children's scores on all conflict IC and pretense tasks were converted into proportions by dividing their total number of points by the maximum number of points available for each task.

Results

Preliminary Analyses—The four IC tasks varied in difficulty (see Table 1), $F(3, 117) = 22.24$, $p < .0005$, $\eta^2 = .36$. DCCS scores were significantly higher than those of all the other tasks (all $ps < .004$) and Head-to-Toes scores were significantly lower (all $ps < .005$). Scores on all the tasks were significantly positively correlated ($rs = .30 - .48$, all $ps < .06$), with one exception: Luria's Hand Game scores were uncorrelated with Grass/Snow scores. The battery showed moderate internal consistency ($\alpha = .67$), and this analysis indicated that α would not increase if any of the scores were removed. In addition, exploratory factor analysis was used to check the unidimensionality of the battery: a principal components analysis confirmed that all four tasks loaded onto the same factor, accounting for 52.4% of the variance. Because these four tasks appear to tap a common construct, scores from all four tasks were averaged to create one conflict IC score for each child.

Predictably, children's performance on all four modified conflict IC tasks was at-or near-ceiling (see Table 1). Composite scores were significantly higher on all the modified IC tasks than composite scores on the non-modified versions (all $ps < .015$), confirming that the modified versions had fewer demands than the true version of the tasks.

Children's scores on the Pretend Actions task were significantly lower than their scores on the other three pretense measures (all $ps < .005$), and they were uncorrelated with all three other measures. No differences were found among scores on Telephone, Impersonation Interview, or Snack Scenario, and performance on these measures were significantly positively correlated ($rs = .34 - .42$, all $ps < .012$). In addition, the internal consistency of

the battery was higher without Pretend Actions scores ($\alpha = .65$) than with them ($\alpha = .59$). Although a principal components analysis revealed that all four scores did load onto a single factor, explaining 46% of the variance, because Pretend Actions scores differed so considerably from the other three tasks, it was removed from further analyses. Thus, children's composite pretense scores were created by averaging Telephone, Impersonation Interview, and Snack Scenario scores.

Age was not significantly correlated to scores on any of the individual or composite measures, a somewhat unexpected finding given that research on children's conflict IC and pretense usually shows improvement in ability over the preschool period. However, the lack of any relation with age in this experiment was likely due to the smaller age range of the participants in this experiment relative to other studies, and not an indication that they were atypical in any way.

Gender was unrelated to the composite pretense scores, but was associated with composite IC scores. Girls ($M = 0.57$, $SD = 0.23$) had marginally higher IC scores than boys ($M = 0.42$, $SD = 0.23$), $t(38) = 2.00$, $p = .053$, Cohen's $d = 0.65$. Examining the individual task scores, it appears this effect was driven by one task in particular, Head-to-Toes, in which girls ($M = 0.40$, $SD = .40$) greatly outperformed boys ($M = 0.11$, $SD = .24$), $t(38) = 2.67$, $p = .01$, Cohen's $d = .88$, an effect that has been found in other research using this task (Ponitz, McClelland, Jewkes, Connor, Farris, & Morrison, 2008).

Main Analyses—A one-way ANOVA comparing children's pretense scores revealed a difference between conditions, $F(2, 52) = 5.19$, $p = .01$, $\eta^2 = .17$. Contrary to hypothesis, children in the conflict IC first condition had higher pretense scores ($M = .62$, $SD = .20$) than children in either the neutral tasks first condition ($M = .42$, $SD = .22$), $t(52) = 2.51$, $p = .02$, Cohen's $d = 0.97$, or the pretense first condition ($M = .40$, $SD = .28$), $t(52) = 2.95$, $p = .01$, Cohen's $d = 0.92$ (See Figure). There was no difference in pretense scores between the neutral first and the pretense first conditions, $t(52) = 0.22$, $p = .83$, Cohen's $d = 0.07$. Thus, instead of hindering children's pretense, engaging in conflict IC tasks boosted it.

To check whether any one particular pretense task drove this effect, scores on each pretense task were compared between the three conditions. Children who participated in the conflict IC first condition had significantly higher scores on two of the pretense tasks: Impersonation Interview, $F(2, 52) = 4.04$, $p = .02$, $\eta^2 = .13$ and Snack Scenario, $F(2, 52) = 3.50$, $p = .04$, $\eta^2 = .12$. Scores on the Telephone task showed the same pattern, however did not reach significance, $F(2, 52) = 2.27$, $p = .11$, $\eta^2 = .08$.

To test whether condition had any effect on conflict IC scores, conflict IC scores were compared between the conflict IC first and the pretense first conditions. Children who experienced the conflict IC test battery first ($M = 0.51$, $SD = .24$) did not perform differently than children who experienced it second ($M = 0.49$, $SD = .26$), $t(38) = 0.18$, $p = .86$, indicating engaging in pretense does not have any immediate effect on conflict IC ability.

An additional question of interest was whether children with greater conflict IC ability also have greater pretense ability. In the two conditions where children completed both, conflict

IC was not correlated with the composite pretense scores after controlling for age ($r = .18, p = .27$). However, interestingly, this relation interacted with condition. Children who participated in the pretense first condition showed a positive relation between conflict IC scores and pretense scores after controlling for age ($r = .49, p = .03$). Yet, there was no relation between conflict IC and pretense when children experienced the conflict IC battery before the pretense battery ($r = .002$ after controlling for age).

Discussion

This experiment explored the role of conflict IC in young preschoolers' pretense ability using an ego depletion paradigm. Children engaged in a series of conflict IC tasks designed to fatigue this ability and then their pretense ability was assessed. If conflict IC is utilized when children pretend, children with fatigued conflict IC should display lower quality pretense than non-depleted children. However, the opposite was found: children who participated in the conflict IC tasks first had higher pretense scores than children who participated in the tasks with the inhibitory demands removed or who pretended first. Thus, experiencing the conflict IC tasks first had a facilitative, not a detrimental, effect on subsequent pretense scores.

An additional finding was that children's scores on pretense and conflict IC batteries were positively correlated, but this was only true in one group of children, those who experienced pretense tasks first. This pattern is consistent with the idea that participation in the IC tasks boosted the quality of children's subsequent pretense beyond what they would have achieved on their own. In other words, children in the pretense first condition had to draw on their conflict IC ability in order to pretend, but children in the conflict IC first condition did not have to, perhaps because it had been previously activated through participation in the conflict IC tasks.

It is interesting that the conflict IC tasks did not have the predicted depleting effect, given that adult versions of conflict tasks (e.g., Stroop tasks) have consistently been shown to have deleterious effects. It could be that the conflict IC tasks used in this experiment were not sufficiently depleting. However, this seems unlikely given that although a few children did quite well, on average children only responded correctly on about half of the trials. Clearly, these tasks were not easy for participants. Whether they were also depleting is an open question. One thought-provoking possibility this finding raises is that depletion may function differently in young children than it does in adults. No research has specifically documented ego depletion in children; future research specifically addressing whether this method is valid in children may be warranted. Another possibility is that children were actually depleted, and it was this depletion that caused the better pretense ability. This possibility is explored further in the General Discussion.

The results from this experiment are certainly intriguing, but they also provoke several questions. First, can the facilitative effect of conflict IC on pretense be replicated? Given this unexpected finding, it seems prudent to ensure it can be replicated in a different sample of young children. Second, is this effect specific to the conflict subtype of IC or would any type of self-regulation boost young children's subsequent pretense? Thus, the goals of Experiment 2 were to replicate the conflict IC first condition of Experiment 1 and to test

whether the facilitative effect found in Experiment 1 is specific to only conflict IC or whether participating in another type of IC would cause a similar increase in pretense scores.

Experiment 2

Method

Participants—Thirty-six 3- and young 4-year-old children participated ($M = 3;10$, $SD = 6.3$ months, 44% female). The sample was 59% Caucasian and 23% Black/African American, with the remaining participants declining to indicate their race. Participants were recruited from a local children's museum, a database of interested families, and area preschools in the Northeast United States. Informed parental consent was obtained for all participants, and children were compensated with a prize.

Design and Procedure—All children were tested individually in a quiet laboratory room, area of their preschool, or the children's museum. Children were randomly assigned into one of two conditions: conflict IC ($M = 4;0$ months, $SD = 7.2$ months, range = 3;0 – 4;9) or delay IC ($M = 3;8$ months, $SD = 4.7$ months, range = 3;1 – 4;3); the two groups did not differ in age, $t(33) = 1.51$, $p = .14$. Children first completed the IC battery corresponding to their condition and then all children completed the same pretense battery as in Experiment 1. Even though the Pretend Actions task was excluded from analyses in Experiment 1, it was retained in this experiment to ensure the children's experience was the same. Pilot testing ensured that each IC battery was about as difficult as the one used in Experiment 1 and took approximately the same amount of time to complete.

Conflict Inhibitory Control Measures—Four new conflict IC measures were selected for this study: Bear/Dragon, Less is More, Whisper, and Day/Night. New measures were chosen to ensure that the observed boost in pretending in Experiment 1 was not caused by some particular aspect of the specific tasks that were used. As in Experiment 1, the order of these tasks was counter-balanced.

In the Bear/Dragon task, children were introduced to two puppets, a “nice” frog and a “naughty” lion. They were told to follow the frog's instructions, but not to follow the lion's instructions. After passing memory check questions, children received 12 trials in a random order, six frog trials and six lion trials, all simple actions (e.g., stick out tongue, touch your head) that were easily done while seated at the testing table. Following Carlson, Moses, and Claxton (2004), trials always alternated. Both puppets were always visible, but the experimenter indicated which puppet was “speaking” by moving the mouth of the appropriate puppet, turning her head to look at the appropriate puppet, and altering her voice.

Less is More was introduced as a “sticker game,” in which the goal was to win more stickers than the experimenter (Carlson, Davis, & Leach, 2005). Two clear, plastic cups were placed in the center of the table equidistant from the child. Small, plastic bowls were placed in front of the child and in front of the experimenter. The experimenter explained that she would put stickers in both cups. The experimenter would get the stickers from the cup the child picked, and the child would get the stickers from the other cup. The experimenter then demonstrated

one trial for the child. After passing memory check questions, 12 test trials began. For each, the experimenter would place one sticker in one cup and three stickers in the other cup (alternating which cup had more) while counting aloud to highlight which cup had more. After the child chose a cup, the experimenter would pour the contents of that cup into her bowl and the contents of the other cup into the child's bowl. Children's score was the number of stickers they won divided by 36 (the maximum possible).

The Whisper task requires children to inhibit their urge to shout out information they know (Kochanska, Murray, Jacques, Koenig, & Vandegest, 1996). First the experimenter had the child practice whispering with her. Then, the experimenter explained (still whispering) that the child would see some pictures and if the child knew who was in the picture, s/he should whisper the character's name to her. The child was also warned that s/he would not know some of the names. After the child passed memory check questions, the experimenter showed the child 12 characters, one at a time, in a random order. Each character was depicted as a colored cartoon on a 4 × 6 inch laminated white card. For each trial, the experimenter placed a card on the table in front of the child and whispered, "Who is this?" Six of the characters were well-known (e.g., Santa Claus and Dora the Explorer) and six were not known at all (e.g., Rainbow Brite and Porky the Pig), as determined by pilot testing. Children's scores were the proportion of well-known characters that they whispered.

For the Day/Night task, children were shown two laminated cards (3 × 4 inches), one white with a yellow sun and one black with a white crescent moon (Gerstadt, Hong, & Diamond, 1994). They were instructed to say "day" when they saw the moon card and "night" when they saw the sun card. After several practice trials with feedback, children completed 12 test trials (six of each type in a random order). The experimenter held up a card for each and then place it face down on the table after the child answered. Scores were the proportion of correct responses.

Delay Inhibitory Control Measures—Children completed four established tasks in a counter-balanced order: KRISP, Gift Delay, Tower Building, and Delay of Gratification.

The Kansas Reflection Impulsivity Scale for Preschoolers (KRISP) is a picture-matching task in which children are presented with several similar black-and-white drawings and are asked to find the one drawing that is identical to a target drawing (Wright, 1971). For each trial, the target appeared by itself on a piece of white paper, and the other drawings were on another piece of paper directly below the target. For each set of drawings, children were asked to "find the one that is the same as this one" as the experimenter pointed to the target drawing. The first two trials were practice trials and feedback was given. For the next 12 test trials, no feedback was given. Children's score was their proportion of correct responses out of 12.

For the Gift Delay task, the experimenter told children that she had something "really neat" to show them in an upbeat, excited voice (Kochanska, et al., 1996). Then, she explained that she wanted to wrap it so that it would be a surprise and asked children to close their eyes until she was done. Once children agreed, the experimenter wrapped a small toy with tissue paper as loudly as possible for 60 seconds. After one minute, children were allowed to

unwrap the toy. To prevent children from becoming distracted in subsequent tasks the toy was put away until the end of the study. This task was scored categorically, with 1 point given to children who did not peek and no points given to children who peeked. The decision to score this task categorically instead of using the more continuous measure of how many seconds children waited before peeking was made for two reasons. First, the position of the video equipment made it difficult to obtain a precise measurement of exactly when some children first peeked. Second, when examining the estimates of how long children waited, it was clear this variable was bimodally distributed: 100% of the children who peeked before the full minute waited less than 30 seconds.

Tower Building is a turn-taking game in which children build a block tower with an uncooperative experimenter (Kochanska, et al., 1996). First, the experimenter showed children a container full of small, colored, wooden cubes and invited children to take turns building a tower. The experimenter defined “taking turns” and asked memory check questions to ensure children understood. If needed, the rules and memory check questions were repeated. The experimenter set down the first block, saying “I’ll go first.” From that point on, the experimenter only took a turn if told to by the child (“It’s your turn!”), if the child handed the experimenter a block, or if 30 seconds passed with no response. The task continued until the tower fell. Scores were calculated by dividing the number of times the child gave the experimenter a turn by the number of possible turns the experimenter could have had.

Delay of Gratification was presented as another “sticker game” (Kochanska, Murray, & Harlan, 2000). Children were shown a bell, a clear plastic cup, and 8 stickers. They were allowed to ring the bell once before the experimenter pulled the bell out of the child’s reach. One sticker was placed on the table and the plastic cup was placed upside-down over the sticker. The child was told they would win the sticker if they waited until the experimenter rang the bell, but if they tried to take the sticker before hearing the bell, the experimenter would win the sticker. Memory check questions ensured that children remembered the rules before test trials began. Children participated in eight test trials, two of each length (10, 15, 20, and 25 seconds). Time began when the experimenter put the cup over the sticker. For the last five seconds of the trial, the experimenter moved her hand from the table and held it over the bell. If the child waited for the bell, they were allowed to retrieve the sticker and play with it before beginning a new trial. If the child did not wait, the experimenter retrieved the sticker and placed it prominently on the table in front of her. Children’s score was the number of stickers they won, divided by eight.

Results

Scoring—All sessions were coded in the same manner as Experiment 1 (videotaped, double-coded at separate times by the same two trained research assistants, with discrepancies resolved by discussion). Again, coders were blind to the experiment’s hypotheses, but not children’s condition.

Preliminary Analyses—A one-way repeated-measures ANOVA indicated that the four conflict IC tasks again varied in difficulty, $F(3, 54) = 4.71, p = .005, \eta^2 = .21$ (See Table 2).

Post hoc tests indicate that Less is More scores were significantly higher than both Bear/Dragon and Whisper scores ($t(54)s = 2.22$ and 3.75 , $ps = .04$ and $.001$) and Whisper scores were also significantly lower than Day/Night scores ($t(54) = 2.33$, $p = .03$). Scores on all the conflict tasks were positively correlated (although not all were significant) with r values ranging from .27 to .60. Again, the highest internal consistency was with all four scores included ($\alpha = .65$), and a principal components analysis revealed all four measures loaded onto a single factor (53.9% of the variance explained). Because these correlations are similar in magnitude to the correlations between the conflict IC measures in Experiment 1 and because they again appear to reflect a unitary construct, scores from all four tasks were again averaged to create one conflict IC score for each child.

The four delay IC measures also varied in difficulty, $F(3, 48) = 9.14$, $p < .001$, $\eta^2 = .36$. Delay of Gratification was easier than all three other tasks (ps range = $.001 - .07$). Gift Delay was more difficult than all other tasks (ps range = $.001 - .009$). Although none of the correlations between the individual tasks reached significance, three showed at least a moderate effect size: Tower Building and Gift Delay ($r = .35$), Delay of Gratification and KRISP ($r = .43$), and KRISP and Gift Delay ($r = .32$). Unsurprisingly, internal consistency for this battery was relatively low ($\alpha = .45$) but would not have improved if any task was removed. A principal components analysis followed by an oblique rotation revealed that a two-factor structure best accounted for the variance: one factor comprising of Delay of Gratification and KRISP and the other comprising of Tower Building and Gift Delay (total variance explained: 71.3%). As such, three delay IC scores were created: a composite averaging children's scores on all four tasks and two sub-scores, an average of Delay of Gratification and KRISP and an average of Tower Building and Gift Delay.

Like in Experiment 1, analyses of the four pretense measures revealed that Pretend Actions scores were anomalous compared to the other three tasks. Internal consistency and principal components analyses showed that Cronbach's alpha increased considerably without Pretend Actions scores (from .43 to .67), and Pretend Actions scores loaded onto a separate factor than the other three tasks (total variance explained by the two-factor solution was 71.7%). Because Pretend Actions scores were again inconsistent and to allow direct comparison with Experiment 1, only scores on the remaining three pretense measures were converted into proportions and averaged to form a single composite score. Age was only correlated with the composite conflict IC score, $r = .70$, $p = .001$. Gender was only correlated with composite delay IC scores. Specifically, girls ($M = 0.68$, $SD = 0.22$) outperformed boys ($M = 0.49$, $SD = 0.11$), $t(15) = 2.33$, $p = .03$, Cohen's $d = 1.09$.

Main Analyses—Children in the conflict IC condition had significantly higher pretense scores than children in the delay conflict IC condition, $t(34) = 2.23$, $p = .03$, Cohen's $d = 0.74$. To alleviate concerns that this effect might be caused by the fact that there were more older children in the conflict condition, an ANCOVA was performed comparing pretense scores by condition while controlling for age. However, no effect of age was found, $F(1, 32) = .05$, $p = .82$, but the difference between conditions persisted, $F(1, 32) = 4.36$, $p = .05$, $\eta^2 = .12$. This result replicates the finding from Experiment 1 that conflict IC tasks boost performance on pretense tasks. It also reveals that this effect is specific to the conflict sub-type of IC and does not extend to delay IC.

A one-way ANOVA comparing children's composite pretense scores from all conditions of Experiment 1 and 2 was also performed and revealed a clear pattern of differences, $F(4, 86) = 3.95, p = .005, \eta^2 = .16$ (See Figure). Post hoc tests show that the two groups of children who engaged in conflict inhibitory control tasks before pretense tasks (from Experiments 1 and 2) had significantly higher pretense scores than all three other groups of children (all $ps < .04$). Importantly, these two groups' pretense scores did not differ ($p = .70$). Further, the pretense scores of the three remaining conditions (pretense first and neutral first from Experiment 1 and delay inhibitory control from Experiment 2) did not differ ($ps = .73 - .92$).

Also replicating Experiment 1, there was no correlation between children's conflict IC and pretense scores ($r = .10, p = .69$). However, there was a correlation between children's overall delay IC and pretense scores (after controlling for age: $r = .61, p = .02$). When examined using the delay IC sub-scores instead of the composite score, a clear pattern emerges. Pretense scores were uncorrelated with the Delay of Gratification + KRISP sub-score ($r = .10$), but significantly correlated with the Gift Delay + Tower Building sub-score (controlling for age $r = .68, p = .01$).

General Discussion

The goal of this study was test the hypothesis that conflict IC is utilized in pretending. If true, depleting children's IC should result in lower pretense ability. However, the opposite was found; children who engaged in conflict IC demonstrated better pretense quality immediately afterwards than children who engaged in delay IC tasks, neutral tasks, or no tasks at all.

It is interesting and important that the facilitative effect of games on pretense was clearly specific to conflict IC. Having children simply play structurally similar tasks or even engage another type of IC did not result in a boost in pretense quality. The inevitable question that follows from these results is: what is special about *conflict* IC? That is, what is the unique component of conflict IC that changes children's pretense? There are several possibilities, which will be discussed in turn.

First, it is possible the conflict IC games were the most fun or engaging, and the positive affect created though this experience carried over into children's pretense. A similar effect has been found in adults: Tice, Baumeister, Shmueli, and Muraven (2007) found that inducing a positive mood increased adults' IC by reducing their susceptibility to ego depletion. However, low pretense scores from the neutral tasks first condition of Experiment 1 and the delay IC first condition of Experiment 2 make it clear that simply playing games and/or positive interactions with the experimenter was not the cause of the boost in pretense scores. However, these conditions could not control for the possibility that children liked the conflict IC games more or found them more fun than the other games. Anecdotally, there is nothing to indicate this was the case. Some children, but not all, found the instruction to make unnatural associations quite funny, but children seemed to enjoy the non-inhibition games and the delay games equally as much.

Second, perhaps it was that the conflict IC tasks were the most challenging for children, serving as a mental warm-up and causing higher quality pretense. Again, the results of the

delay IC condition from Experiment 2 do not support this explanation. Composite delay IC scores did not differ from conflict IC scores, suggesting children found both types of games equally difficult. This leaves the explanation that it was one or more of the specific requirements of conflict IC tasks that caused the increase in pretense scores.

Despite the superficial differences in the eight different conflict IC tasks used in this research, they all share key features of 1) resisting a natural impulse, 2) making an unnatural response, and 3) switching back and forth between two rules. Delay IC tasks also require the first of these steps, to resist an impulse, but they do not involve the others. To succeed on a delay IC task, children must resist their urge to respond right away, but when the time comes to respond, the correct response is the natural one. Further, there is only one rule to keep in mind in delay tasks – stop or wait. Since delay tasks did not induce higher quality pretending, the requirement they share with conflict tasks, to resist an impulse, is likely not responsible for boosting pretense.

Perhaps the conflict IC tasks modeled the experience of doing something inconsistent with reality by requiring children to make novel associations. Russ and her colleagues have reliably found a positive relationship between the quality of children's pretend play and their divergent thinking ability, the ability to generate unique ideas (e.g., Russ & Grossman-McKee, 1990; Russ, Robins & Christiano, 1999; Russ & Schafer, 2006). Other research has shown that explicit instruction in originality and fluency does help grade-school children improve their scores on a variety of creativity and divergent thinking measures (Lee, Bain, & McCallum, 2007). It could be that it was easier for children to conceive of pretend actions and scenarios after having just experienced a variety of counterintuitive actions, like touching green for "snow" or picking the cup with one sticker in order to get three stickers.

Or, maybe it was the experience of representing and managing two conflicting rules that facilitated children's pretense. Pretense requires children to represent both reality and an altered version of reality while also managing the two. For instance, when a child creates pretend cookies in real bowls, the child adds an unreal element to the known, real properties of the bowls in order to create the pretense. This concurrent representation of both real and pretend is perhaps similar to the demands of a conflict IC task, in which children must keep two rules in mind simultaneously. Determining whether it was the exposure to novel associations or the experience of holding two versions of a representation in mind, or both, which caused the increase in children's pretense scores is an interesting question for future research to pursue.

There is an additional possibility: it could be that participating in the conflict IC tasks did deplete children's self-regulatory capabilities. Ego depletion usually causes deficits, but might it have the opposite effect for pretending? It may be that being temporarily uninhibited may spark less scripted or more imaginative pretending in children. IC helps avoid distracting thoughts. However, sometimes such thoughts prove fruitful by leading an individual down an unexpected or creative path. A child with depleted IC might be more willing or able to pretend something less ordinary. There is some evidence that lower IC is associated with increased creativity in adults. White and Shah (2006) found that adults with Attention Deficit Hyperactivity Disorder scored both higher than normal controls on

divergent thinking (creativity) and lower on an inhibition task. And, Carson, Peterson, and Higgins (2003) showed that latent inhibition, the ability to ignore irrelevant stimuli, was negatively correlated with several measures of creativity in undergraduates.

If it were true that lower inhibition results in better pretense, one would expect a negative correlation between the two. However, the opposite relationship was found in this study. When children engaged in pretense *before* conflict IC, these abilities were positively correlated. However, this effect was not present and there was no correlation when the order of the tasks was reversed, likely due to the fact that task order changed children's overall pretense scores. This pattern of results echoes the relationship between theory of mind and conflict IC. Several studies have found that conflict IC predicts theory of mind ability, but theory of mind does not predict conflict IC (e.g., Hughes, 1998b; Carlson, et al., 2004), leading to the supposition that the relationship between the two abilities is directional - conflict IC is needed to represent others' mental states, but theory of mind is not needed for success in conflict IC tasks. The fact that conflict IC and pretense scores were only correlated in children who experienced the pretense tasks first, and that conflict IC boosted pretense scores but not vice versa, suggests conflict IC might function similarly in pretense. It appears that conflict IC is recruited when children pretend, but pretense is not needed when playing conflict IC games. Taken together, the present and previous research point toward the general conclusion that conflict IC is an essential tool for dealing with representational situations in which children must consider both reality and an alternative to reality.

But, if conflict IC is needed in order to pretend, it is unclear why pretending did not boost children's subsequent conflict IC scores in Experiment 1. Engaging in pretense theoretically should have engaged children's conflict IC, which conceivably could have made them more successful on the conflict IC tasks. Yet, children's conflict IC performance was unaffected, making it clear that the transfer effect seen in this research is unidirectional, not bidirectional. Why this is the case is an interesting question in need of further exploration. Perhaps it is because pretense is a more complex behavior and requires a variety of other skills besides conflict IC, like symbolic thinking ability, and thus children's conflict IC is not sufficiently "warmed-up" by pretending to affect their conflict IC performance. Or, perhaps the conflict IC tasks used in this research measured children's maximum ability, making them relatively impervious to transfer effects.

Even without knowing the exact reason why conflict IC boosted the quality of young children's pretense, but not vice versa, this finding may have implications for early childhood education. There has been considerable recent interest in documenting the benefits of play-based preschool (e.g., Hirsh-Pasek, Golinkoff, Berk, & Singer, 2009). One argument in favor of playful learning is that it teaches children how to self-regulate; for example, the preschool curriculum *Tools of the Mind* specifically calls for teachers to use socio-dramatic play as a way to develop children's self-regulatory skills (Bodrova & Leong, 1996). And, research confirms that preschoolers exposed to this curriculum out-perform children exposed to other curricula on a variety of executive function measures (Diamond, Barnett, Thomas, & Munro, 2007). Thus far, researchers have focused on using dramatic play to strengthen IC. However, the present research suggests that perhaps educators can

also use conflict IC to strengthen pretense quality. One can easily envision how games like the conflict IC tasks used in this research could be incorporated into preschool settings. These tasks require minimal set-up and materials, very little training for teachers, and are fun for children. And, since most simply involve instructing children to do the opposite of something natural, it would be easy for teachers to develop their own games.

Of course the pretense that was assessed in this research is different from the pretense children exhibit in preschools. In this research, children were asked to perform specific pretend actions and scenarios chosen by an adult experimenter. However, in their everyday behavior, children's pretense is not so rigidly directed by adults. It is unclear whether engaging in conflict IC would provide a similar boost to children's naturalistic or spontaneous pretend play. Investigating this question is one logical next step for research to pursue. And, the conclusions that can be drawn from this research are limited by both the restricted age range tested and the fact that it is unknown how long the facilitative effect of engaging conflict IC would persist. It may be that as children become more advanced pretenders, their pretense becomes more automatic and requires less IC. Whether this effect would be seen in other age groups and how long it lasts are two other sensible directions for future inquiries to take.

The ability to inhibit and the ability to pretend are both remarkable achievements in early childhood. Results from this research add to extant knowledge of both IC and pretense by showing that they are related in interesting, but nuanced, ways. Children who can easily make unnatural associations and those who can wait demonstrate higher quality pretense in an adult-guided play session. However, these two types of IC seem to contribute to pretense in different ways, as evidenced by the fact that engaging children's conflict IC, but not their delay IC, increased their subsequent pretense quality. It may be that conflict IC is needed in order to meet the representational demands required by pretending, while delay IC helps children with the demand characteristics of the task (e.g., listening to experimenter's instructions, thinking about one's response before acting). This is just one of a number of intriguing hypotheses sparked by this research for future investigations to pursue. Learning exactly how IC and pretense relate and interact with one another may help us more fully understand the value of challenging children to control their minds and bodies and allow educators to create more effective curricula to build these skills.

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Figure 1.

Figure Mean pretense scores by condition in Experiments 1 and 2. Standard errors are represented by errors bars in each column. Children in the conflict IC first condition in Experiment 1 and its replication in Experiment 2 had significantly higher pretense scores than children in all other conditions.

Table 1

Descriptive Statistics for Individual Tasks by Condition in Experiment 1

Measure	Conflict Inhibitory			Pretense First			Neutral First		
	<i>M (SD)</i>	Observed Range	<i>M (SD)</i>	Observed Range	<i>M (SD)</i>	Observed Range	<i>M (SD)</i>	Observed Range	<i>M (SD)</i>
DCCS	0.72 (0.26)	0.42 – 1	0.78 (0.24)	0.42 – 1	0.93 (0.16)	0.42 – 1	0.93 (0.16)	0.42 – 1	0.42 – 1
Luria's Hand Game	0.48 (0.36)	0 – 1	0.40 (0.31)	0 – 0.92	0.86 (0.24)	0 – 0.92	0.86 (0.24)	0.25 – 1	0.25 – 1
Head-to-Toes	0.27 (0.34)	0 – 0.83	0.26 (0.39)	0 – 1	0.95 (0.12)	0 – 1	0.95 (0.12)	0.67 – 1	0.67 – 1
Grass/Snow	0.56 (0.38)	0 – 1	0.54 (0.40)	0 – 1	0.93 (0.13)	0 – 1	0.93 (0.13)	0.5 – 1	0.5 – 1
Pretend Actions	0.30 (0.31)	0 – 0.8	0.24 (0.33)	0 – 1	0.26 (0.26)	0 – 0.8	0.26 (0.26)	0 – 0.8	0 – 0.8
Telephone	0.61 (0.36)	0 – 1	0.33 (0.38)	0 – 1	0.44 (0.37)	0 – 1	0.44 (0.37)	0 – 1	0 – 1
Impersonation Interview	0.66 (0.22)	0 – 1	0.43 (0.32)	0 – 1	0.44 (0.29)	0 – 1	0.44 (0.29)	0 – 1	0 – 1
Snack Scenario	0.63 (0.30)	0 – 1	0.45 (0.35)	0 – 1	0.38 (0.21)	0 – 0.67	0.38 (0.21)	0 – 0.67	0 – 0.67

Note. Data for the four IC tasks for children in the Neutral First condition reflect their scores on the modified versions of these tasks (the inhibitory demands were removed from each task).

Table 2

Descriptive Statistics for Individual Tasks by Condition in Experiment 2

Conflict Condition		Delay Condition	
		Inhibitory Control Measures	
<i>M (SD)</i>	Observed Range	<i>M (SD)</i>	Observed Range
Bear/Dragon	0.51 (0.47)	0 – 1	KRISP 0.62 (0.19) 0.1 – 0.9
Whisper	0.36 (0.44)	0 – 1	Gift Delay 0.29 (0.47) 0 – 1
Less is More	0.73 (0.21)	0.39 – 1	Tower 0.63 (0.24) 0.14 – 0.94
Day/Night	0.62 (0.36)	0 – 1	Delay of Gratification 0.79 (0.26) 0.25 – 1
		Pretense Measures	
<i>M (SD)</i>	Observed Range	<i>M (SD)</i>	Observed Range
Pretend Actions	0.43 (0.35)	0 – 1	0.31 (0.35) 0 – 1
Telephone	0.58 (0.30)	0 – 1	0.47 (0.33) 0 – 1
Impersonation Interview	0.69 (0.25)	0.22 – 1	0.52 (0.28) 0.11 – 1
Snack Scenario	0.51 (0.34)	0 – 1	0.29 (0.25) 0 – 1