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The Development of Representations of Pretend Object Substitutions

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Abstract

Many theories of how pretense is mentally represented have been posited, but none have been effectually empirically tested to date. This research is the first to explore how children and adults mentally process simple pretend actions, specifically pretend object substitutions, and whether this representation changes with age. Preschoolers, older children, and undergraduates heard or read about a variety of pretend object substitutions, and their reaction time to name an image related to the object's real identity, pretend identity, or an unrelated image was measured. To test what is unique to pretense, these reaction times were compared to those from participants who responded to the same images after reading about non-pretend versions of the same actions. Results suggest that preschoolers inhibit reality when representing a pretend action, older children activate an object's real and pretend identities equally, and adults activate the object's real identity more than the pretend one. Implications for current theories of pretense representation are discussed.

Keywords

representation; pretense; inhibition; naming

The ability to pretend and understand others' pretense are abilities that emerge very early in development, usually around children's second birthdays (Haight & Miller, 1993; Harris & Kavanaugh, 1993). Pretending is often first thought of as an activity which contributes to social development, and a wealth of research has confirmed this intuition, showing that pretending is associated with high quality relationships (Howe, Petrakos, Rinaldi, & LeFebvre, 2005; Slade, 1987) and good social skills (Connelly & Doyle, 1984). But, the ability to pretend and understand others' pretense is also an important milestone in cognitive development. Not only is pretending a key sign of emerging symbolic competence (Lillard & Kavanaugh, 2014), it is positively correlated with children's understanding of other's minds (Taylor & Carlson, 1997) and aspects of emerging literacy, like vocabulary size and narrative construction (Trionfi & Reese, 2009). Yet, little is known about the specific mental process(es) that underlie pretense. That is, what exactly happens in the mind when a person is exposed to a pretend action that allows him/her to understand it as pretense?

Several theories of pretense representation have been put forth over the course of the past three decades, beginning with Leslie (1987)'s influential metarepresentational theory which subsequently inspired other cognitive scientists and philosophers to put forth their own ideas (e.g., Currie, 1998; Friedman, 2013; Harris, 2000; Jarrold, Mansergh, & Whiting, 2010; Lillard, 2001; Nichols & Stich, 2000; Perner, 1991; Rakoczy, Tomasello, & Striano, 2004; Stich & Tarzia, 2015). The history of the debates amongst these thinkers and the specifics of each theory have been well-documented elsewhere so will not be reiterated in detail here. In sum, theories do agree on a few points: representations of pretense are different from representations of other actions/mental states in some way, and they must be kept separate from one's representations of reality in order to prevent pretend experiences from changing one's real-world knowledge. In other words, pretend experiences must be "quarantined" to avoid damage to one's representations of reality, a phenomenon termed *representational abuse* (Leslie, 1987). However, theories do differ on a number of key dimensions, namely whether or not *pretend* is a mental state, whether pretending requires physical behavior, and when in development children acquire a mentalistic concept of pretense. What is most germane to this paper is that presently no one theory is generally accepted, primarily because empirical evidence to support any individual theory over another has proven elusive.

Further, all of the extant theories do not account for recent research which points to the involvement of self-regulation, and specifically inhibitory control, in pretense in young children. A positive correlation between inhibitory control and pretense ability has been found in several studies (Carlson, White, & Davis-Unger, 2014; Elias & Berk, 2002; Van Reet, 2014). Further, engaging preschoolers' inhibitory control has been found to boost their subsequent pretense quality (Van Reet, 2015). These findings echo a well-established correlation between inhibitory control and another representational ability, children's understanding of false beliefs (e.g., Carlson & Moses, 2001; Hughes, 1998; Perner & Lang, 1999). It has been argued that this link between inhibitory control and false belief understanding reflects the fact that children need inhibitory control to inhibit the real state of the world in order to represent an alternative to reality (i.e., the false belief). For instance, to correctly answer a question about an object that has been surreptitiously moved from one location to another, children need to inhibit their knowledge of where the object really is in order to see the situation from a character's perspective. It stands to reason that inhibitory control would provide a similar function in pretense, allowing children to inhibit reality in order to generate a pretend alternative. Stated more concretely, in order to understand the act of pretending a banana is a telephone, children may need to inhibit their representation of "banana" and activate "telephone". The present research was designed to test this hypothesis. To do so, a reaction time paradigm, which is a well-established method in cognitive psychology to measure activation and inhibition of semantic representations, was employed. While this sort of task has not been used to investigate representations of pretense to date, it has the potential to shed new light on the unanswered questions regarding how children and adults process pretend actions described above and reveal information that methods used to date (e.g., behavioral tasks and neuroimaging) cannot.

The overall goal of this experiment is to explore what happens on a representational level when people are exposed to basic, prototypical pretend actions and whether this changes with age. To do so, preschoolers, older children, and adults heard or read about pretend

object substitutions (i.e., one object standing in for another, like pretending a block is a car) and then their reaction times to the real and pretend identities of the object used in each object substitution were measured using a standard naming paradigm. Preschoolers were included because this is youngest age group for which a reaction time paradigm can be reliably used: research confirms that automatic cognitive inhibition processes are in place and can be measured using reaction time in preschoolers (Pritchard & Neumann, 2004). Older children were included because they represent an interesting middle ground between preschoolers and adults – they are still active pretenders like preschoolers (Smith & Lillard, 2012), but they have an adult-like, mentalistic understanding of pretense rather than preschoolers' action-based understanding (Lillard, 1993). In addition, the question of whether pretend representations are unique was assessed by comparing the pattern of activation caused by exposure to the pretend actions to a condition in which participants heard/read about equivalent real actions.

It was hypothesized that, after reading/hearing about pretend actions (but not real ones), participants would respond more slowly to the real identities of the objects used in the pretense scenarios compared to the objects' pretend identities, reflecting the idea that representing pretense requires inhibition of reality in order to represent an alternative to that reality. Further, the size of this difference is expected to decline with age, because children will likely need to exert more inhibitory control than adults due to their less developed inhibitory control ability and their fewer years of experience representing pretend actions. In other words, in order to process pretend object substitutions, participants, especially children, will inhibit reality, and no inhibition will be necessary to comprehend non-pretend actions.

Method

Participants

Forty-four 4- and 5-year-old children ($M = 59.25$ months, $SD = 7.0$ months, 38% female) and thirty-eight 8–10-year-old children ($M = 111.16$ months, $SD = 11.0$ months, 66% female) participated. Seven preschool children and one older child were excluded from final data analyses due to failure to complete the entire procedure or inattention during the procedure, causing too many outliers. The sample was primarily Caucasian and middle-class, reflecting the demographics of the area (mid-size Northeastern city in the United States). Children were recruited from a database of families interested in research maintained by the principal investigator or from a local children's museum. Informed consent was obtained from all parents/legal guardians, verbal assent was obtained from preschool children, and written assent was obtained from older children. Children were compensated with a small prize.

In addition, 56 undergraduates ($M = 19.2$ years, $SD = 1.1$ years, primarily Caucasian and female) participated. All participants were fluent English speakers. Sixteen participants were excluded from final data analyses because their dataset contained too many outliers, the majority of which were due to equipment error (many adults' voices became softer as they became more comfortable with the procedure and they would fail to trigger the microphone). Participants were recruited from a participant pool maintained by the author's institution or

through on-campus advertising. Informed consent was obtained from all participants, and they were compensated with either partial course credit or \$5.00.

Materials

All stimuli were presented on a desktop or laptop computer using the software package SuperLab 4.5 with a SV-1 Voice Key attached (Cedrus Corporation). Twenty four two-sentence descriptions of a person performing a pretend object substitution were created (See Appendix). No object was used more than once. In all of the descriptions, the name of the real object was explicitly used. In half of the descriptions, the name of the object's pretend identity was also used (e.g., "Rose has a pair of scissors. She pretends that they are a microphone while singing along to music."). In the other half, the pretend identity was implied but its name was never used (e.g., "Sarah just returned home. She takes a paperclip out of her purse and pretends to unlock the door."). The names of the object's real and pretend identities were never the last word of the description. The total length of all the descriptions was approximately equivalent ($M = 19.04$ words, $SD = 1.73$ words). For the control condition, all the descriptions were revised to remove any reference or implied reference to pretending. The structure and length of the sentences ($M = 18.08$ words, $SD = 2.53$ words) were kept as similar as possible, with only minor changes to ensure the descriptions remained coherent (See Appendix). In addition, 5 two-sentence descriptions of non-pretend, everyday actions were used during practice trials to familiarize participants with the format and procedure of the experiment.

Three images were associated with each description. All images were stock color photographs on white backgrounds; they were obtained from various online image libraries. One image represented the real identity of the object in the description and one represented the pretend identity; the images either exactly reflected the description (e.g., the target word in the description was "rug" and the image was of a rug) or they were highly associated with the description (e.g., the target word was "grape" and the image was of a bunch of grapes). The third image was completely unrelated to the description. Twenty-six additional images were used during the practice and familiarization portion of the experiment. No image was ever used twice.

Design and Procedure

Participants were assigned to either the pretend condition or control condition. Participants were not randomly assigned to condition because the control condition was conducted after the pretend condition. However, participants were recruited in an identical manner and care was taken to ensure the participant characteristics in each condition were as similar as possible. For the preschool children, the final sample included 19 children in the pretend condition ($M = 58.0$ months, $SD = 7.4$ months, 45% female) and 18 children in the control condition ($M = 61.1$ months, $SD = 5.9$ months, 26% female). For older children, the final sample included 18 children in the pretend condition and 19 children in the control condition (pretend: $M = 110.7$ months, $SD = 8.6$ months, 63% female; control: $M = 111.5$ months, $SD = 13.0$ months, 68% female). For undergraduates, the final sample included 20 individuals in each condition (pretend: $M = 18.63$ years, $SD = 0.88$ years, 89% female; control: $M = 19.83$ years, $SD = 1.34$ years, 83% female).

Participants were seated at a desk at a comfortable distance from the desktop monitor or laptop screen. They either wore a headset microphone or held the microphone directly in front of their mouths if they objected to wearing it. First, participants identified images out loud to become comfortable with the microphone and to allow the experimenter to calibrate the microphone. For each of the practice images, a black fixation cross appeared in the center of the screen for 250 ms, the image then appeared in the center of the screen and remained until a voice response was registered by the computer, and lastly, a sentence instructing participants to press the space bar whenever s/he was ready to proceed appeared.

Next, the experimenter explained in developmentally-appropriate language that in between the images, the participant would see and hear (preschool and older children) or see (adults) short stories. Children were told to listen to the stories and shout out the name of any images as soon as s/he saw them. Adults were instructed to read the stories silently but name the images out loud as quickly as possible and to take a break in between trials whenever they wanted. The 5 practice trials preceded the 24 test trials. For adults, the experimenter remained next to the participant during the practice trials to ensure the participant understood the procedure and then stood behind him/her (but remained in the same room) during the test trials. The experimenter stayed next to children through the entire procedure in order to read the vignettes aloud. The decision to read aloud to children but allow adults to read silently to themselves was primarily driven by pilot testing. Many older children struggled to read the vignettes by themselves and spontaneously asked the experimenter for help reading. But, adults reported that having an experimenter read to them was odd and very distracting. The decision to keep the text on the screen for children, even though they were not expected to read it, was also the result of pilot testing. A blank screen often caused inattention: children would scan the room, look down at their hands, or begin fidgeting. None of the data from participants who participated in this pilot testing was saved – it was used only to develop the procedure, so it is not included in the analyses reported in this manuscript.

Each trial proceeded as follows: 1) the two-sentence vignette appeared on a white screen in black, 48-point, Arial font and remained on the screen for 6 seconds (pilot testing ensured this was enough time to read the vignettes out loud), 2) a black fixation cross appeared for 250 ms, 3) one of the three images associated with the trial (the object's real identity, the object's pretend identity, or an unrelated object) was randomly selected by the software and appeared until a voice response was registered, 4) instructions to press the space bar when ready for the next trial appeared. Reaction time in milliseconds to name the images was recorded. Trials were presented in a random order determined by the software, with the only constraint that each trial could only appear once. The entire procedure took about 10 minutes for adults and 15 minutes for children. After all trials were completed, participants were debriefed, thanked, and compensated.

Results

Because reaction time decreases so markedly with development, data from each age group were analyzed separately. All responses below 250 ms were discarded because they represented equipment error, not true reaction times. For adults and older children, all

responses above or below 2.5 standard deviations away from each participant's median response were treated as outliers and discarded. However, preschoolers' standard deviations were very large, and thus, using the same criterion (2.5 SD) would have resulted in reaction times that were very large being included. The goal of eliminating outliers was to remove data that did not represent reaction time, like trials in which participants sneezed or the equipment malfunctioned. Because preschoolers naturally have slow reaction times, it was difficult to determine which large values were true reaction times and which were the result of errors. To be conservative, a criterion that eliminated these very large values was used for preschoolers: responses 1000 ms above or below each child's median response were treated as outliers and discarded. Although some true reaction times may have been discarded using this criterion, this seemed preferable to including values that were the result of an equipment error or anomaly.

If more than one-third of participants' responses from test trials (i.e., eight or more) were discarded for any reason, their entire datasets were eliminated from the analysis. The average number of trials that were discarded in the remaining datasets (i.e., the ones used in the final data analyses) was 5.2 for preschoolers, 5.0 for older children, and 2.8 for adults. These were equally distributed among image types (preschoolers: $F(2, 70) = 0.65, p = .53$; older children: $F(2, 70) = 0.19, p = .83$; adults: $F(2, 88) = 1.46, p = .24$).

After excluding trials under 300 ms and outliers, each participant's mean reaction time to real and unrelated images was calculated. For pretend images, trials in which the pretend identity of the object was explicitly named in the vignette (exact trials) were separated from trials in which it was not (implied trials), and then mean reaction time to pretend-exact and pretend-implied trials were calculated. Even though there was no "pretend identity" in the control condition, the images that were related to the pretend identity in pretend condition were still labeled as "pretend" for comparison purposes. These data were analyzed with three 4 (image type) $\times$ 2 (condition) mixed Analysis of Variances (ANOVA), one for each age group. All these analyses were also repeated without the two trials in the control condition in which the word "wishes" was used to replace the word "pretends." Although wishing is a different mental state than pretend, it does similarly invoke an unreal state of the world, so it is possible these sentences were not adequate controls for their pretend versions. However, there was no difference in any result for any age group without these two trials. Thus, the analyses using data from all trials are reported below.

Preschoolers

For preschoolers, there was no main effect of image type, $F(3, 90) = 0.80, p = .50$. A main effect of condition was found, $F(1, 30) = 7.76, p = .009, \eta^2 = .21$, such that children generally responded more quickly in the pretend condition than the control condition. However, this main effect was qualified by a significant interaction between condition and image type, $F(3, 90) = 3.19, p = .027, \eta^2 = .10$ (See Figure 1). To explore this significant interaction, two one-way repeated measures ANOVAs were performed comparing reaction times to each image type, one for each condition. In the pretend condition, there was a main effect of image type, $F(3, 45) = 3.81, p = .016, \eta^2 = .20$. As hypothesized, post hoc tests with a LSD correction show that children were slowest to respond to the image associated with

the real object used in the vignette than any other image (compared to pretend-exact: $t[45] = 1.95$, $p = .07$; compared to pretend-implied: $t[45] = 6.37$, $p < .0005$; compared to unrelated: $t[45] = 3.74$, $p = .002$). There were no differences between pretend-exact, pretend-implied, and unrelated images (all p s $> .70$). In the control condition, children responded equally to all image types, $F(3, 45) = 0.42$, $p = .74$.

Older Children

For older children, there was no main effect of condition, $F(1, 34) = 0.16$, $p = .70$, and no interaction between condition and image type, $F(1, 34) = 1.71$, $p = .17$, revealing that older children showed the same pattern of activation after hearing about pretend and real actions. There was a main effect of image type, $F(3, 34) = 6.40$, $p = .001$, $\eta^2 = .16$. Post hoc tests (with an LSD correction) show that participants were slower to name the unrelated image than either of the objects that were explicitly named in the vignette (real image: $t[34] = 4.41$, $p < .0005$; pretend-exact image: $t[34] = 4.20$, $p < .0005$). But, there were no other differences between image types.

Adults

For adult participants, a main effect of image type was also found, $F(3, 36) = 15.74$, $p < .0005$, $\eta^2 = .30$. Post hoc tests show that, as expected, participants were slowest to unrelated images (compared to pretend-exact: $t(36) = 5.36$, $p < .0005$; compared to pretend-implied: $t(36) = 2.27$, $p = .029$; compared to real: $t(36) = 8.73$, $p < .0005$). However, unexpectedly, they were faster to real images than both types of pretend ones (compared to pretend-implied: $t(36) = 3.20$, $p = .003$; compared to pretend-exact: $t(36) = 3.26$, $p = .002$). There was no difference in reaction times between pretend-exact and pretend-implied images, $t(36) = 1.32$, $p = .20$ (See Figure 3). There was also a main effect of condition, such that participants responded more slowly to vignettes containing pretend actions, $F(1, 36) = 7.16$, $p = .011$, $\eta^2 = .17$. There was no interaction between image type and condition.

Summary

First, preschoolers responded quicker to images after hearing vignettes containing a pretend action than ones describing a real action, older children responded equally as fast to the two, while adults responded slower to vignettes about real actions than pretend ones. Second, participants in all age groups responded differently to the four image types (although the preschoolers only did so in the pretend condition). Specifically, preschoolers were slowest to name the image of the object that was really used in the vignette but did not respond differently to the images which reflected the object's pretend identity compared to an unrelated object. Older children were slowest to name the objects that were completely unrelated to the vignettes, but they did not differentiate between the images representing the real and pretend identities of the objects in the vignettes. Opposite of the preschoolers, adults responded fastest to name the objects really used in the vignettes, and similar to the older children, they responded slowest to the image of the unrelated object.

Discussion

The goal of this experiment was to document for the first time how individuals represent simple pretend actions and how this process develops from the preschool period to early adulthood, with an eye specifically towards elucidating the role of inhibitory control in representations of pretense. It was hypothesized that, after reading or hearing about pretend object substitutions, 1) participants would be slower to respond to images related to the real identity of the object used in the substitution and this difference would decrease with age and 2) the pattern of activation seen in response to pretend actions would be different than the pattern seen after reading/hearing about similar real actions. The results provide some support for these hypotheses and disconfirm others. The differences between responses to pretend and real actions will be discussed first, followed by the differences between image types will be discussed.

A clear developmental trend was present in participants' overall reaction times to pretend versus real actions. Preschoolers responded more quickly to pretend actions than real ones, older children responded with equal speed in both conditions, and adults showed the opposite pattern of preschoolers – they were slower to respond to pretend actions than real ones. These data may reflect that pretend actions are easier for young children to represent and harder for adults to represent than real actions. But why might they have been easier or harder? It seems unlikely that these differences were due comprehension of the actions, given that all the objects and actions used were highly familiar. However, it is possible that preschoolers' difficulty with the real actions was due to the sometimes awkward construction of the real action descriptions. Because the sentences were adapted from the pretend action descriptions with the goal of keeping the arrangement and length as similar as possible, some of the real descriptions used uncommon structures. The real action descriptions also differed in that they usually described two actions, compared to the single action in the pretend descriptions. For example, pretending a piece of bread was a sponge was adapted to eating a piece of bread *and* using a sponge. It is possible that the working memory demand of representing two actions was too much for preschoolers and subsequently caused their slower responses. Alternatively, the overall pattern could be explained by interest in the actions. Preschoolers, who typically spend a large amount of their free time pretending (Haight & Miller, 1993), may have found the descriptions of pretend actions more engaging than the descriptions of real actions. This may have led to increased attention to the pretend actions and quicker responses. Adults on the other hand, who do not typically pretend in the child-like way described in the vignettes (i.e., by performing pretend object substitutions) (Smith & Lillard, 2012), may have been less interested in pretend actions and attended more to real actions.

There was also a developmental trend in how similar the pattern of activation to pretend versus real actions was. Only preschoolers showed a significantly different overall pattern of activation to pretend actions compared to real ones. However, this difference may have been due to their difficulty with or disinterest in the real actions, as described above, not an indication that they represent pretense and reality differently. Recall that many theories of pretense argue that pretend representations need to be unique so that individuals do not confuse pretend events with real ones, a confusion which could lead to inaccurate

representation of the real world (e.g., Leslie, 1987). The present data hint that pretend and real representations may not as different as theorized, at least in older children and adults. However, only one type of pretense and one aspect of these representations was measured in this research. It is certainly possible that some other facet serves to set pretend and real representations apart. Elucidating what that might be or what other mechanism prevents representational abuse is an interesting direction for future research. An alternative explanation for this result is that, because the real actions were described using fictional characters and situations, they were processed similarly to the descriptions of pretend actions. It may be that all unreal information is subject to the same quarantining mechanism that mentally protects representations of real-world knowledge from being altered.

Examining patterns of activation more closely reveals what participants activated and/or inhibited after exposure to the pretend and real actions. In the pretend condition, only the preschoolers responded as hypothesized. They were much slower to the object's real identity than they were to the object's pretend identity or an unrelated object, suggesting that exposure to a pretend object substitution caused inhibition of the object's real identity. This finding is consistent with recent findings showing that inhibitory control is positively correlated with preschoolers' pretense quality (Carlson, White, & Davis-Unger, 2014; Van Reet, 2014) and the longstanding finding that inhibitory control is needed when preschoolers are asked to represent situations involving conflicting states, like false beliefs (e.g., Carlson & Moses, 2001). The present data add to these extant findings by pinpointing the exact role inhibitory control may play in children's early representational abilities: in order to understand unreal or conflicting states, children must inhibit their representation of reality. It is important to note that baseline inhibitory control ability was not assessed prior to this task. Because random assignment was not used, it is possible that the difference between conditions was caused by children in the pretend condition having stronger inhibitory control ability. However, given the equivalent recruitment procedure and mean age in the two conditions, this seems unlikely.

It is surprising that preschoolers were not also quicker to respond to the pretend identities than the unrelated objects, which would have been evidence that the representations of the pretend identities were activated. In other words, after hearing about someone pretending a piece of bread is a sponge, why would "sponge" not be more mentally accessible than "crayon"? It may be that this lack of activation is another component, in combination with the inhibition of reality, of the quarantining mechanism that keeps pretend representations separate from real-world knowledge. Perhaps any degree of activation would pose a risk of representational abuse. However, it may also be that the naming paradigm used to measure reaction time in this experiment was not the best method to measure activation in this age group. Anecdotally, some young children found the microphone uncomfortable and/or distracting, and shy children had to be coaxed to speak more loudly. As a result, preschoolers' responses were more variable than the other age groups', which sometimes made them hard to interpret. For example, as described previously, establishing a criterion which separated large, but valid, reaction times from true outliers was difficult. Future research might try utilizing a touchscreen response instead, given that touchscreens are more familiar to young children than microphones. And, more exploration of how young children's reaction time data is best cleaned and analyzed would be helpful.

In contrast, older children and adults responded more quickly to the real and pretend identities than the unrelated object. This shows that, after hearing about a pretend object substitution, older children and adults activated both the object's real and pretend identities. The activation of these identities is relatively unsurprising considering the long-established finding that if individuals are exposed to a concept, it subsequently becomes active in semantic memory (Hutchinson, 2003). In a pretend context, this link would be quite problematic because it could result in representational abuse. For example, if "block" and "cookie" are simultaneously activated as a result of pretending a block is a cookie, and thus become linked in semantic memory, an individual might subsequently associate blocks with edibility. Current theories of pretending certainly would have not predicted the present results, concurrent activation of both the real and pretend identities, due to this danger of representational abuse. These results raise several questions: Is representational abuse actually a problem that theories of pretense need to address? If so, how is representational abuse is being prevented in these age groups, especially in the older children who showed equal activation of real and pretend identities? It is important to note that adults did differentiate between the real and pretend identities, just in the opposite direction of the preschoolers. Contrary to hypothesis, adults were faster to respond to the real identities than the pretend ones. Thus, even though both the real and pretend identities were activated, perhaps the way representational abuse is prevented in this group is that they are activated to different degrees.

Of course many major questions remain. For one, pretense comes in a wide variety of forms, ranging from using an object as itself (e.g., pretending to talk on a real phone), to creating imaginary objects, to impersonating a character, to the completely mental exercises of imagining and daydreaming. However, this research focused on only one type of pretense, object substitution. It remains to be seen whether the patterns of activation and inhibition seen in this research would also be seen if participants read about other forms of pretense. On one hand, object substitution is a highly prototypical form of pretense, so one might predict that all or most pretense would be treated similarly by the mind. For instance, pretending to be a superhero might involve weak activation (or inhibition) of one's real self and stronger activation of the superhero's identity. However, it is unclear how this model would translate to other types of pretense, like the creation of imaginary objects. If one pretended to eat with an imaginary spoon, perhaps "spoon" would be activated, but what about the real state? Would a concept of "nothing" also be inhibited? A second question concerns whether the method of exposure to pretense affects comprehension of it. Specifically, does it matter whether a pretend action is described in words? Or, would processing be similar if participants had seen still images or videos of people performing the pretend object substitutions? Lastly, do people process a pretend action the same way when they actually perform it themselves? Research on motor representations hint they would: imagined and real actions represented similarly (Glover & Dixon, 2013), even though but may have different neural underpinnings (Macuga & Frey, 2012). These are all apt and interesting questions for future research.

Another series of questions this work inspires is whether comprehending pretense is similar to processing of other types of non-real information, like understanding false premises, counterfactuals, or metaphors. Theoretically, there is some reason to expect it would be: all

share the central feature of needing to represent two conflicting states, reality and some alternative to reality. And, examining the extant literature on adults' representations of false premises and counterfactuals, some similarities seem to exist. For example, when exposed to false premises and counterfactuals, adults activate both the real state and the alternative state of the situation (Ferguson & Sanford, 2008; Schroyens & Braem, 2011), just as they activated both the real and pretend identities of the object used in pretense in this experiment. However, due to the major differences in methodology and stimuli among these various experiments, it is prudent not to draw any conclusions. Research directly comparing these various types of non-real scenarios is needed in order to determine whether the mind handles them all in the same way.

Although there has been a long and considerable debate concerning how pretense is mentally represented, this research is among the first to empirically investigate how minds process simple pretend actions and how this ability changes with age. In sum, these data suggest that pretend actions are processed differently than similar real ones in preschoolers, but not in older children and adults, which hints that there is a qualitative change in how pretend actions are processed sometime between the preschool period and middle childhood but that the change between middle childhood and adulthood is more one of degree. Confirming this hypothesis and then determining what motivates the change in childhood away from requiring inhibition in order to represent pretense are interesting directions for the future. This research also provides more evidence that inhibitory control is recruited in order to understand pretend actions in young children. In regard to theories of pretense representation, it seems sensible that future theories should both include a role for inhibition and allow for the possibility that representational abuse may be prevented by different mechanisms in different age groups. Given how many outstanding questions remain, hopefully these experiments are just the beginning of a series of inquiries into what is special (or not) about the uniquely human ability to pretend.

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Appendix: Pretend Object Substitution and Corresponding Real Action Descriptions

Pretend Condition	Control Condition
Dave is in a waiting room. He picks up a magazine and pretends to eat dinner off of it.	Dave is in a waiting room. He picks up a magazine and decides to eat his dinner.
Sam likes magic. He waves his index finger back and forth and pretends to cast a spell.	Sam likes magic. He waves his index finger back and forth and wishes he could cast a spell.

Pretend Condition	Control Condition
Jill is carrying her blanket. She pretends it is a cape by tying it around her neck.	Jill is carrying her blanket. She helps her sister put on a cape by tying it around her neck.
Adam is in the kitchen. He puts a pot on top of his head and pretends to be a king.	Adam is in the kitchen. He puts a pot on top of his head and wishes he could be a king.
Sarah just returned home. She takes a paper clip out of her purse and pretends to unlock the door.	Sarah just returned home. She takes a paperclip out of her purse before unlocking the door.
Emily is waiting for a friend. She looks at the rubber band on her wrist and pretends to check the time.	Dan is waiting for a friend. He looks at the rubber band on his wrist and then checks the time.
Joey is watching his friends play a game. He holds up his wallet and pretends to take a picture of them.	Joey is watching his friends play a game. He puts his wallet away so that he can take a picture of them.
Steve is playing at home. He jumps on a rug and pretends that he is riding a wave.	Steve is playing at home. He jumps on a rug while watching a surfer ride a wave on TV.
Anna is finished eating dinner. She holds a fork to her mouth and pretends to scrub her teeth clean.	Anna is finished eating dinner. She holds a fork to her mouth and later scrubs her teeth clean.
Lauren is on a bus trip. She puts strings up to her ears and pretends to listen to music through them.	Lauren is on a bus trip. First she plays with strings and puts them up to her ears, and then she listens to music.
Greg just finished his juice. He flips over his cup and pretends it is taking off into space.	Greg just finished his juice. He flips over his cup and thinks about launching into space.
Patrick is in his backyard. He picks up a stick and pretends to paint a picture on the sidewalk.	Patrick is in his backyard. He picks up a stick and watches his brother paint a picture on the sidewalk.
Rose has a pair of scissors. She pretends that they are a microphone while singing along to music.	Rose has a pair of scissors. She picks up a microphone and sings along to music.
Gary has some pencils. He pretends they are drumsticks and bangs them on the desk at school.	Gary has some pencils. He also has drumsticks which he bangs on his desk at school.
Erica is reading a book. She closes it and pretends to use it as a pillow because she is tired.	Erica is reading a book. She closes it and rests her head on a pillow because she is tired.
Jacob has a stapler on his desk. He pretends it is a phone by putting it up to his ear and talking on it.	Jacob has a stapler on his desk. He picks up his phone, puts it up to his ear and talks on it.
Jackie wraps a towel around herself. She pretends that she is wearing a dress while getting ready.	Jackie wraps a towel around herself. She then puts on a dress and gets ready.
Julie has just taken off her shoe. She pretends that it is a truck that is driving down the street.	Julie has just taken off her shoe. She then sees a truck that is driving down the street.
Lucy has a piece of bread. She pretends to use it as a sponge to wash the dishes.	Lucy has a piece of bread. She eats it then uses a sponge to wash the dishes.
Andrew is sweeping the floor with a broom. He stops and pretends to play the guitar with it.	Andrew is sweeping the floor with a broom. He stops and decides to play guitar.
Chris is playing with a frisbee. He pretends to be wearing a mask by putting it up to his face.	Chris is playing with a frisbee. He then puts on a mask which covers his whole face.
Lisa is playing with her wagon. She pretends to use it as a lawn mower while wheeling it around the lawn.	Lisa is playing with her wagon while her mother wheels a lawn mower around the lawn.
Sean finds a piece of paper. He pretends it is a ball when he crumples it up and throws it.	Sean finds a piece of paper. He then picks up a ball and throws it to his friend.
Scott is eating grapes. He pretends that one is a bug and squishes it on the table.	Scott is eating grapes. He sees a bug and squishes it on the table.

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Figure 1. Preschoolers' mean reaction time by image type and condition. Note: bars represent standard errors.

Figure 2.
Older children's mean reaction time by image type and condition. Note: bars represent standard errors.

Figure 3. Adults' mean reaction time by image type and condition. Note: bars represent standard errors.