Pretend play as a context for learning new information

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Abstract

Many parents and educators advocate for an increased role for pretend play in early childhood education. They argue that pretending benefits children emotionally, socially, and cognitively. Pretend play is highly motivating for young children, so it could potentially be a useful tool to engage students with new material; however, there is little direct evidence that pretend play is useful as a context for teaching new information. In fact, it could be very difficult for children to learn new information that is presented in a pretend context because they tend to quarantine pretend worlds from reality. Several studies have investigated whether children can learn information presented in fictional stories, but comparatively few have considered the analogous question in pretend play: Can children learn new information that is embedded in a pretend context, and how does this learning compare to other non-pretend learning activities? The current study found that neither realistic nor fantastical pretend play influenced children's learning of novel object categories or their analogous transfer of a novel problem solving strategy. Learning was predicted by children's ability to discriminate fantasy from reality, suggesting that learning from play is an advanced cognitive strategy that involves separating realistic from implausible information. This work can inform the policy debate about the use of pretend play in early childhood education and provides a stepping stone for future investigations into the role of pretense and fantasy in learning.

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Introduction

The daily lives of young children are filled with encounters with fictional worlds. According to a Kaiser Family Foundation report, children under 6 spend, on average, 59 minutes per day watching television, 24 minutes per day watching movies, and 40 minutes per day reading or being read to (Rideout & Hamel, 2006). Additionally, starting at around 18 months, children regularly engage in creating their own fictional worlds through pretend play. It seems strange that children would spend such a large proportion of their time engaged with fictional worlds at a time in their lives when they have so much yet to learn about the real world. One possible explanation is that fiction is in fact a vehicle through which children learn more about reality. Many stories and television shows are quite similar to the real world, and children's pretend play is often focused on everyday themes such as playing house, school, or doctor's office (Haight & Miller, 1993; Rubin, Fein, & Vandenberg, 1983). Many children's books are explicitly written to teach children about topics as diverse as what happened to the dinosaurs or what will happen when they become a big brother or sister. Through fiction and pretend play, particularly with more knowledgeable play partners, children may gain exposure to words, objects, and ideas they would not have encountered otherwise.

Two of the major figures in the early history of developmental psychology disagreed on the role of pretend play in early development. Piaget believed that pretend play was an indicator of immature cognitive mechanisms (Piaget, 1962; Sutton-Smith, 1966). Pretend play during the pre-operational period represented an extreme form of assimilation; when pretending, children are changing the world around them to fit their own mental representations, rather than adjusting their mental states to fit the world as it is. Piaget believed that as children transitioned into the

concrete operational stage, they abandoned pretend play in favor of more structured, rule-based games.

In contrast, Vygotsky (1967) believed that pretend play was a critical component of early child development. He believed that play creates a "zone of proximal development" in which children are capable of more complex thought than they would be otherwise. Through play, children develop the ability to follow rules, inhibit impulses, and think symbolically. The latter was a particularly important development. Through early play, especially with substitute objects, children begin to separate the meaning of objects from the objects themselves: a critical step in the development of symbolic thought. In pretense, "an object [. . .] becomes a pivot for severing the meaning of horse from a real horse" (p. 15). Pretense helps develop the abilities to mentally represent an object that is not present and to recognize that a present object can stand for one that is absent. This early symbolic understanding is critical for language development and abstract reasoning, and Vygotsky argued that early pretend play is an essential driving force behind these later cognitive achievements.

Pretend Play in Education

Following this Vygotskian view, some researchers, educators, and policy makers have campaigned for an increase in the amount of preschool time spent on play in general (Ginsburg et al., 2007; Hirsh-Pasek, Golinkoff, Berk, & Singer, 2008; Zigler & Bishop-Josef, 2004), and pretend play more specifically (Bodrova, 2008; Diamond, Barnett, Thomas, & Munro, 2007; Kaufman, Singer, & Singer, 2012). Those who campaign for more play in early education argue that it benefits the development of a variety of cognitive and socio-emotional skills, and that it is a more developmentally appropriate approach to preschool education than direct instruction.

Skill development. Decades of research has attempted to show that pretend play is an important causal factor in the development of a variety of domains, including intelligence, creativity, language, emotion regulation, theory of mind, social skills, and executive function. Although pretend play is correlated with many of these abilities, the evidence for a causal role is lacking (see Lillard et al., 2013 for a review).

It has also been argued that pretend play may be important because it encourages the development of causal reasoning and counterfactual thinking (Amsel, Trionfi, & Campbell, 2005; Buchsbaum, Bridgers, Weisberg, & Gopnik, 2012; Dias & Harris, 1988; Gopnik & Walker, 2013). Pretend play and counterfactual reasoning share many important features. Pretense starts with the establishment of a non-literal premise; for example, a child will decide to pretend that an empty teacup contains tea. The pretend episode is then elaborated from there. The child can pour the pretend tea into a cup, pretend to drink it, and pretend that the table will be covered in tea if the cup tips over. Similarly, reasoning counterfactually begins with considering something that did not or has not actually happened and imagining the implications (e.g., "What would happen to this block tower if a block were removed from the bottom?"). Reasoning through the effects of a counterfactual premise is a valuable tool in learning about causal structures; in wondering whether *a* causes *b*, one can imagine what would happen if *a* were not true. Therefore, pretend play may be a way in which children learn about the world through the construction and elaboration of counterfactual scenarios.

In support of this theory, early work in this area found that children were better able to reason about logical syllogisms with counterfactual premises (e.g., "All cats bark. Tom is a cat. Does Tom bark?") when they were told to pretend that the premise was the true (Dias & Harris, 1988; see also Amsel et al., 2005; Hawkins, Pea, Glick, & Scribner, 1984). Such syllogisms are

typically difficult for young children because they resist the initial premise that contradicts what they know about the world. However, in this study the pretend frame encouraged children to imagine what would happen *if* the premise were true. Follow up work showed that other manipulations that prompted temporary acceptance of the counterfactual premise had similar positive effects on children's performance (Dias & Harris, 1990; P. L. Harris & Leevers, 2000; Leevers & Harris, 1999).

Other recent studies have suggested that children can reason about causal structures during pretend play (Gopnik & Walker, 2013) and that their ability to do so correlates with their reasoning about the same causal structures in the real world (Buchsbaum et al., 2012). However, what both of these studies show is that children can use their real-world causal knowledge within pretend play to predict the outcomes of pretend actions. No evidence as of yet shows that engaging in pretend play improves children's ability to reason about causal relations. The findings of Dias and Harris (1990) suggest that pretend play is just one way to encourage counterfactual thinking in children; other non-pretend manipulations, such as encouraging children to picture the counterfactual premise in their heads, were equally effective. Correlational evidence in other domains, such as theory of mind (Taylor & Carlson, 1997) and executive function (Carlson, White, & Davis-Unger, 2014), suggests a similar view: Pretend play is a context that elicits behaviors that aid development, but it is not a necessary causal factor in and of itself (see Lillard et al., 2013 for a review). As such, there would be little harm in encouraging children to engage in pretense, but it is not a necessary component of early development.

Guided play vs. direct instruction. According to Vygotsky, because pretend play represents a zone of proximal development, cognitive skills are encouraged through structured play with more advanced partners. Consistent with this view, several studies have shown that

guided play is more effective as a teaching tool than direct instruction (Fisher, Hirsh-Pasek, Newcombe, & Golinkoff, 2013; Han, Moore, Vukelich, & Buell, 2010; Stipek, Feiler, Daniels, & Milburn, 1995). Guided play typically involves an adult scaffolding a child's exploratory play, setting up a structured play activity, commenting on the child's observations, and asking guiding questions. For example, Fisher et al. (2013) taught children about new geometric shapes through guided play, direct instruction, or free play. In the guided play condition, an adult helped children explore the shapes by asking questions designed to help them discover the defining properties of each shape category, and encouraging children to trace the shapes and compare them to each other. In the direct instruction condition, the adult presented the same information, but did not engage children in the activity; children viewed passively while the adult explored the shapes. They found that guided play led to better performance on a subsequent shape identification task, and the effect was maintained 1 week later.

Guided play has also had positive effects on teaching vocabulary (Han et al., 2010), general academic achievement (Stipek et al., 1995), and academic motivation (Stipek et al., 1995). However, the "guided" part of guided play is a critical component. Free play, where children engage in self-directed activities with little to no adult scaffolding, has consistently been shown to be less effective than guided play (see Alfieri, Brooks, Aldrich, & Tenenbaum, 2011 for a meta-analysis; Chien et al., 2010; Fisher et al., 2013; Honomichl & Chen, 2012). Together, these studies suggest that playfully engaging a child in a learning experience will lead to better outcomes, but that some adult scaffolding is necessary.

Curricular approaches. The Tools of the Mind program (Bodrova & Leong, 2007) is a formalized curriculum based on this Vygotskian view that development is encouraged through structured pretend play. The program involves a variety of activities intended to encourage the

development of executive function skills. Many of the activities involve pretending. Although initial implementations of this curriculum showed positive effects on executive function skills (Barnett et al., 2008; Diamond et al., 2007), these results have not replicated in other samples (Clements, Sarama, Unlu, & Layzer, 2012; Farran, Lipsey, & Wilson, 2011). Even in the studies that found positive results, it is not possible to determine whether the improvements were due to the pretend play or to other aspects of the program.

Other intervention studies have shown beneficial outcomes—such as increased academic achievement, school readiness, and motivation—for children in classrooms that incorporate play into their daily routines (D. G. Singer, Singer, Plaskon, & Schweder, 2003; J. L. Singer & Lythcott, 2004). However, as with Tools of the Mind, it is difficult to tell whether the positive effects in these interventions are due to play generally, to pretend play specifically, or to other aspects of the curriculum.

Learning new information from pretend play. Proponents of the play-based approach to early education believe that establishing good reasoning, self-regulation and social skills early on is crucial to later academic achievement (Bodrova, 2008; Hirsh-Pasek et al., 2008; Kaufman et al., 2012), but time spent on these skills could take time away from academic subjects, such as math and reading. However, a middle ground may exist if pretend play can benefit the learning of academic material. None of the studies discussed in the previous section have investigated whether embedding information into a pretend context will help children learn that specific information. The primary focus in this area of research has been on more general skills, such as executive function (Barnett et al., 2008; Diamond et al., 2007), creativity (J. L. Singer & Lythcott, 2004), and reasoning (Buchsbaum et al., 2012). It remains an open question whether pretend play can be helpful for learning specific information.

Learning new information from pretend play and fiction could potentially be a very cognitively complex process, because research suggests that children generally keep pretense and fiction separate from reality. For example, preschool children tend to say that characters and events in books are not real and did not happen in real life (Woolley & Cox, 2007). Research into pretend play has shown that preschool children generally know that things that happen during a pretend game are not real; for example, they know that you cannot really see, touch, or eat a pretend cookie (Wellman & Estes, 1986). If children categorize everything that happens during pretense as "not real", this could extend to novel information as well. For example, if one child pretends to use a whisk to stir pancake batter while playing house, their play partner, who has never heard of whisks before, may think that whisks are just pretend, like magic wands or a genie's lamp. This would make it very difficult, if not impossible, for children to learn new information from a pretend or fictional context. Learning from such contexts would require a cognitive mechanism that determined which pieces of novel information were applicable to the real world, and transferred only that information while quarantining everything else.

In spite of this potential theoretical obstacle, studies have shown that children are capable of learning information from some types of fictional worlds. Children can learn facts about objects (Ganea, Pickard, & DeLoache, 2008), animals (Ganea, Ma, & DeLoache, 2011), natural selection (Kelemen, Emmons, Schillaci, & Ganea, 2014), and other types of general knowledge (Marsh, Meade, & Roediger, 2003) from realistic storybooks. In my own work, we showed that children could learn some novel information from a pretend context, but the inferences they drew differed from inferences drawn by children who learned the same information in a real context (Hopkins, Dore, & Lillard, 2014).

Children were told a novel label and function for a familiar object, either in a real setting ("This screwdriver is also a 'sprock'") or in a pretend setting ("Let's pretend that this screwdriver is a 'sprock'"). Children in the real condition seemed to learn the novel word as simply another label for the familiar object, selecting another screwdriver when asked to choose a sprock from a set, and demonstrating that sprocks are used to screw in screws. In contrast, children in the pretend condition seemed to form a new concept of the category "sprock"; they showed a bias to assume that real sprocks would be shaped like screwdrivers, choosing other long, skinny objects when asked to find a real sprock. They also demonstrated the novel function we had taught them when asked what sprocks do. This study and others (Sutherland & Friedman, 2012; 2013) suggest that children do not automatically dismiss any new information they encounter during pretense as "just pretend".

However, we cannot tell from these studies how effective pretend play is as a context for learning compared to other non-play activities. The differences observed between the real and pretend conditions in our study were qualitative, not quantitative. As discussed above, many studies have attempted to show that pretend play improves various cognitive outcomes (including creativity, intelligence, social cognition, and executive function) more so than other non-pretend activities (see Lillard et al., 2013 for a review), but very few have focused on the effect of pretense on learning new information. More evidence is needed on the nature of children's learning from pretend contexts.

The present study is designed to investigate the impact of pretend play and fantasy content on children's learning of new information. In some ways, learning from fictional sources may be very similar to learning from any other context. First, children must consider both the plausibility of the information itself, including whether it contradicts anything they already know

and whether it violates any known principles of how the world works. They also consider the reliability of the source (Koenig & Harris, 2005; Koenig, Clément, & Harris, 2004). However, when the source of the information is fictional, there are the additional steps of transferring the information across the boundary between reality and fiction and applying it to a real context. In the remainder of this introduction, I will review each of these steps. First, I will consider the nature of the fiction-reality boundary. Second, I will consider factors that influence children's judgments of specific pieces of information, including the effects of context and source. Finally, I will discuss how the process of analogical transfer is used to apply learned information to a new context.

Fiction-Reality Boundary

Theories about the nature of the fiction-reality boundary exist on a continuum from a completely permeable boundary at one to end to a strict quarantine around fiction at the other. Few theorists would advocate for the extreme versions of either of these views. The more likely possibility exists somewhere in the middle: that there is selective transfer of information between reality and fictional worlds. However, the extremes are useful to consider as anchors for this continuum. Although children encounter many types of fictional worlds, including books, oral narratives, movies, television, and pretend play, much of the theoretical work on the boundary with reality has focused on pretense specifically, as this is one of the earliest and most prevalent forms of fiction that children encounter. Hence I will consider the ends of the reality-fiction continuum in the context of pretense.

If the boundary between pretense and reality were completely permeable, we would expect children to be in a constant state of confusion about what was real. A child who observed their mother pretend that a wood block was a cookie would then believe that wood was edible

and would modify their category of cookies to include blocks. Although children do occasionally exhibit some confusion about whether the things they have pretended really exist (Bourchier & Davis, 2000; P. L. Harris, Brown, Marriott, Whittall, & Harmer, 1991; Samuels & Taylor, 1994), they also demonstrate an understanding that objects that they have imagined, pretended, or dreamed about cannot be touched or experienced in the same way as real objects (Estes, Wellman, & Woolley, 1989; Wellman & Estes, 1986). They do not seem to suffer from what Leslie (1987) termed "representational abuse", where their understanding of the real world would be modified by any new information they encounter through pretense or fiction.

To explain children's ability to protect their real world representations from being damaged by pretense, Leslie (1987) proposed that pretense is quarantined, preventing information from pretense from leaking into reality. From an early age, children can recognize pretend play as a special case, and any actions tagged as pretend are decoupled from the real actions they represent. In this way, children can engage in pretend play and understand the actions involved without any modification to their concepts of the real world. However, the boundary between reality and fiction must allow some information to pass through, at least in the real-to-fiction direction, because what is pretended is often based on what is real. Children use their knowledge of the real world to construct their pretend games (Nichols & Stich, 2000). Having decided to pretend that an empty teacup contains tea, they then can use their real knowledge of tea and cups to pretend to drink the tea or pretend that the table will become wet if the cup spills (P. L. Harris & Kavanaugh, 1993). Similarly, adults use knowledge about the real world to fill in the gaps in books or movies; they assume that some facts about the real world are also true of the world of a story even if they are never explicitly mentioned (Weisberg & Goodstein, 2009).

If we accept that pretend play and fiction are mostly kept separate from reality, but that information can be transferred from reality into fiction, then we must consider the possibility that the boundary between reality and fiction is semi-permeable. The next step is to determine whether and when information crosses the boundary from fiction to reality, and whether this process is systematic and selective or represents a breakdown of an otherwise strict quarantine system. The latter would mean that information in pretense and fiction is generally not allowed to affect our concepts and representations of reality, but that under some circumstances information accidentally crosses over. For example, it has been suggested that pretend-reality confusion is more likely to occur when the pretend episode is emotionally charged (Lillard, 1994; Samuels & Taylor, 1994; Woolley, 1997), and even adults experience real emotional reactions to books or movies that they know are not real (Lang, Kozak, Miller, Levin, & McLean, 1980; Lang, Melamed, & Hart, 1970). In these cases, vivid emotional reactions may temporarily derail the quarantine system and create confusion as to whether the fiction is real.

Additionally, work with adults has suggested that they often adopt the characteristics of fictional characters. After reading an excerpt from *Harry Potter* or *Twilight*, adults showed stronger implicit associations with wizard or vampire words (Gabriel & Young, 2011); they also explicitly endorsed statements regarding wizard- or vampire-like traits (e.g., "Do you think, if you tried really hard, you might be able to make an object move just using the power of your mind?" and "How sharp are your teeth?"). Adults have also been shown to conform to stereotypes about the characters in stories that they read; they rated themselves as smarter after reading a narrative about a professor and as more attractive after reading about a cheerleader (Galinsky, Wang, & Ku, 2008).

Similar findings extend to digital avatars as well: Adults who were randomly assigned a taller or more attractive avatar in a virtual reality environment behaved more confidently both within the virtual reality and in face-to-face interactions afterwards (Yee & Bailenson, 2007; Yee, Bailenson, & Ducheneaut, 2009). Although these studies suggest a potential breakdown of the quarantine system in terms of fictional or virtual characters influencing real-world behavior, none of these studies show that adults were subsequently confused about the reality status of those characters. Additionally, most of this work has not been extended to children, so it is not clear whether they would be similarly affected.

The alternative to a strict quarantine system that breaks down under some conditions is that transfer of information from fiction to reality represents a sophisticated cognitive strategy; as discussed above, most fictional worlds are populated with real-world information mixed with the pretend, and children might transfer only the real information while quarantining anything that is just pretend. A selectively permeable boundary is the most likely possibility that would allow for learning from pretense and fiction. Strict quarantine would not allow for any learning because no information from fictional worlds would be allowed access to real-world representations, and a completely permeable boundary would lead to indiscriminate acceptance of all information included in fiction. In order to learn from fictional sources, children would have to selectively transfer only the real information while quarantining everything else. This would require an evaluation of any new information encountered in a fictional context to determine its plausibility and decide whether to transfer it to reality. Next, I will review factors that influence children's judgments of novel information.

Evaluating the information. The first step in learning new information is evaluating the information itself to decide if it is plausible. This is especially important when learning from

fictional sources because they can contain many people, objects, and locations that do not exist in reality; the learner must decide whether new information is likely to be true or relevant in the real world. Such new information can range from realistic but fictional (such as Tom Sawyer or Avonlea) to fantastical and impossible (such as Harry Potter, magic carpets, or Narnia).

Across many studies children have shown an ability to discriminate between real and fictional entities along a number of dimensions and in a variety of different ways. Young preschoolers know that thoughts are different from objects (Estes et al., 1989; Wellman & Estes, 1986), and they distinguish toys, pictures, and pretense from real things (Woolley & Wellman, 1990). For example, Wellman and Estes (1986) found that children recognized that objects could be seen, touched, acted on, and perceived by other people but that thoughts could not. This work shows that children can judge categories of concepts (objects, toys, thoughts, etc.) as real or not real. Another body of work has investigated which factors influence children's judgments of whether specific items (particularly novel ones) are real. Some of the factors that have been suggested to have an effect on children's reality judgments are emotional valence, local context, possibility, and cultural context.

Emotional valence. As discussed earlier, some research has suggested that children's judgments about the reality status of pretense or fiction are influenced by emotional content. Harris and colleagues (1991) asked preschoolers to pretend that there was a scary monster in one box and a nice puppy in the other. Although the majority of children correctly said that the monster and puppy were not real, most children chose the puppy box when asked which they would like to open. Additionally, when given the choice of putting their finger or a stick inside either box, children were less likely to use their finger for the monster box than for the puppy box. Harris et al. (1991) concluded that although children can state explicitly that things they

have pretended are not real, their actions suggest that they are not fully convinced. However, Golomb and Galasso (1995) failed to replicate these results, suggesting that the confusion evidenced by children in the original study was at least partly due to their continuing to play along with the original pretend premise. Bourchier and Davis (2000) concluded that these two accounts may apply to different sets of children; more credulous children are influenced by the emotional content of the pretense, but other more skeptical children may play along while remaining aware that the pretend objects are not real.

Samuels and Taylor (1994) argued that emotional content influenced *explicit* reality judgments in preschoolers: Children did not reliably discriminate between real and fantasy events when the content of each was frightening. However, this result was driven by the fact that children were less likely to say that the real, frightening events could happen in real life than that the real, neutral events could; judgment of the fantasy events was not affected by emotional content. This suggests that children may be driven by a desire to deny the possibility of frightening events, but it is not strong evidence for the influence of emotional content on explicit judgments about fantasy. Consistent with this interpretation, Carrick and Quas (2006) found that preschool children were more likely to say that happy and neutral events could happen than angry or frightening events, regardless of whether they were real or fantastical. Therefore, responding on these tasks may reflect what children would like to see happen rather than what they believe could actually happen. Thus, there is not strong evidence that emotional valence influences children's ability to distinguish reality from fantasy.

Local context. Children's judgments of whether something is real are also influenced by the immediate context in which the information is presented. Woolley and Van Reet (2006) presented 3- to 6-year-olds with descriptions of novel items defined either in fantastical terms

("dragons collect *surnits*"), scientific terms ("scientists collect *surnits*"), or everyday terms ("children collect *surnits*"). Four-, 5-, and 6-year-olds categorized the novel entity as real significantly more often when it was described with scientific information than when it was described with fantastical information.

Children can also use the presence of relevant evidence to make reality judgments: Tullos and Woolley (2009) read children descriptions of novel animals ("Takins eat twigs and always leave twigs behind wherever they go"). The children then saw evidence that was either relevant to deciding whether the animal was real (an animal cage with twigs in it), irrelevant (a cage with feathers), or else they were given no evidence at all (an empty cage). Four- and 5-year-olds showed no differences in reality judgments across the different types of evidence, but children 6 years and older were more likely to say the novel animal was real when presented with relevant evidence. Similarly, belief in a novel entity—the Candy Witch, who brings children toys after Halloween—was stronger when parents staged a visit from her for their children, but this effect was more pronounced in older children (Woolley, Boerger, & Markman, 2004); the authors argue that older children are better able to incorporate the visit as evidence when forming their beliefs in the novel character.

Possibility. Another factor that influences children's reality judgments is whether the novel entity violates any known physical or biological principles. Preschoolers are adept at detecting such violations (Johnson & Harris, 1994; Rosengren, Kalish, Hickling, & Gelman, 2011; Shtulman & Carey, 2007), and their judgments of events as possible or impossible influence their reality judgments. Children as young as 3 years old judge a character in a story to be pretend if the character does impossible things, such as using a blanket to become invisible or eating a magical cookie that makes one live forever (Corriveau, Kim, Schwalen, & Harris, 2009).

Four- and 6-year-olds also say that novel machines that perform impossible functions, such as shrinking objects or making flowers talk, are not real (Cook & Sobel, 2010). These studies together suggest that possibility is a strong cue for children's judgment of the reality of a story, character, or artifact. However, there are cases in which children are induced to believe in seemingly impossible events and characters if they are endorsed by their culture.

Cultural endorsements. Children's judgments of reality are influenced by the beliefs of the culture in which they live. For example, 5-year-olds were more likely to say that events in religious stories could occur than events in fantastical stories, although 4-year-olds did not make the same distinction (Woolley & Cox, 2007). Vaden and Woolley (2011) further investigated this, comparing Bible stories with closely matched non-religious versions (only names and references to God were changed). They found that, with age, children were increasingly more likely to say that the religious stories had characters that were real and that the events did actually happen, even if the events violated physical laws; this was especially true for children whose parents reported higher religious involvement.

This work on religion is one example of how children's exposure to cultural beliefs affects their understanding of reality; children judged the same event differently depending on whether God was perceived to be responsible. In both of these studies, the influence of religion increased with age, suggesting that children's reality judgments are increasingly affected as they gain exposure to their culture's beliefs. When the adults around them explain that sometimes God makes seemingly impossible things happen, this is incorporated into their understanding of the fantasy/reality distinction.

Another obvious case of cultural influence on belief is adult endorsement of fantastical entities such as Santa Claus, the Easter Bunny, and the Tooth Fairy. Children are encouraged to

believe in these characters through stories, movies, and songs as well as rituals (sometimes quite elaborate) carried out by their parents and teachers. Using such techniques, Woolley, Boerger, and Markman (2004) were able to induce belief in a novel fantasy character: the Candy Witch. All children were introduced to the Candy Witch through an activity at their preschool; she was described as a nice witch who would bring children a toy after Halloween. The subset of children whose parents arranged a "visit" from the Candy Witch at their home had the highest levels of belief. Endorsement by adults likely leads to children expressing belief in beings like Santa Claus or the Easter Bunny at higher rates than non-endorsed fantasy beings, like mermaids, ghosts, or monsters (P. L. Harris, Pasquini, Duke, Asscher, & Pons, 2006), even though Santa Claus violates children's understanding of physical and biological principles.

However, children are less confident in the existence of Santa Claus and the Easter Bunny than of invisible, scientific entities, such as germs or vitamins (P. L. Harris et al., 2006); this may be partly due to the pattern of testimony children hear about these different categories. The existence of scientific entities like germs is implicitly assumed in the way we talk about them (e. g., "don't eat that; it has germs on it"); adults rarely overtly state a belief in germs, whereas they often do so about Santa Claus. Woolley, Ma, and Lopez-Mobilia (2011) found that 9-year-olds were sensitive to these differences in communication: They were less likely to say that novel entities were real when they heard informants explicitly state a belief in those entities. Thus, although children are persuaded by adult endorsement that fantasy characters and other invisible entities (like germs) are real, they are sensitive to subtle differences in the testimony they receive about such entities.

The evidence reviewed in this section shows that children do not accept wholesale any new information they encounter, but rather that they consider a wide set of factors to determine

whether something is likely to be true or real. This consideration is especially important when encountering new information in fiction because much of what is depicted in fiction may be untrue or impossible. For example, when children read *Thomas the Tank Engine*, they should learn that trains run on tracks and require fuel, but not that they have faces and talk to each other. For pretense and fiction to be useful as educational tools, children must be able to discriminate the plausible information from that which ought to be quarantined. Evaluating the information itself is one important piece of this process; evaluating the source of the information is another.

Evaluating the source. As discussed above, children's beliefs in God and Santa Claus are examples of how the source of information can interact with judgments about the information itself: Children accept the word of trusted adults over their own intuitions that these characters seem impossible. In what other ways does the source of information influence children's judgments about what is real? We know that children evaluate people as potential sources of information (Koenig et al., 2004) and are more or less likely to trust the same information depending on who provides it. For example, older children (9 – 13 years old) were more likely to discount apparent contradictions of conservation when they were performed by a magician than when they were performed by a scientist or a priest (Chandler & Lalonde, 1994). Younger children are influenced by source as well: They correctly judge that events in fantastical story books could not happen in real life (Woolley & Cox, 2007).

This last finding suggests that, similar to how they judge people as reliable informants, children might evaluate the reliability of *stories* as potential sources of information. Young children have been shown to learn novel facts from stories. Preschoolers learned novel biological facts about animals (Ganea et al., 2011) and the principles of natural selection (Kelemen et al., 2014) from storybooks; they can even integrate facts learned across multiple stories (Bauer &

San Souci, 2010). However, a number of studies have shown that children are more likely to learn novel information from realistic books than from unrealistic or fantastical ones. For example, the iconicity of illustrations in books affects children's learning: Toddlers were more likely to learn novel object labels (Ganea et al., 2008) or a novel action sequence (Simcock & DeLoache, 2006) from a book with photographs or realistic drawings than from a book with cartoonish illustrations. When books used anthropomorphized illustrations and descriptions of novel animals, preschoolers were less likely to learn novel facts about those animals (Ganea, Canfield, Simons, & Chou, 2014). Similarly, preschoolers were less likely to transfer novel problem-solving strategies (Richert & Smith, 2011; Richert, Shawber, Hoffman, & Taylor, 2009) or novel causal principles (Walker, Ganea, & Gopnik, 2012) from fantastical stories than from realistic ones.

These findings could mean that children are responsible about what they learn from fiction; they learn novel information when the story is realistic, but not when it is fantastical. However, many studies have shown that children and adults will also learn incorrect facts from realistic fiction (see Marsh, Butler, & Umanath, 2012 for a review), even if participants are warned that the story may contain incorrect information (Marsh & Fazio, 2006) or if the incorrect facts are highlighted in the text (Eslick, Fazio, & Marsh, 2011). This may have to do with how children and adults conceptualize fictional worlds.

Representing fictional worlds. Young children (4-6 years old) conceptualize fictional worlds as separate from reality and from other fictional worlds. They say that a character from one story (e.g., Batman) can see, touch, and talk to a character from within the character's own story (e.g., Robin), but not a character from another story (e.g., SpongeBob); they also recognize that real people cannot interact with fictional characters (Skolnick & Bloom, 2006). Adults

similarly draw boundaries around fictional worlds (Skolnick & Bloom, 2006), but they also infer that fictional worlds will share some properties with reality. Weisberg and Goodstein (2009) asked adults whether certain real world facts (such as "two plus two equals four" and "Washington, DC, is the capital of the United States") were true in the world of a story they had read, even though they were not explicitly stated in the story. Adults' judgments were influenced by how realistic the stories were; they were more likely to say the real-world facts were true in the story if the story contained no explicit violations of reality. However, when the story character could do impossible things, such as teleport or talk to animals, adults were less likely to infer that facts about the real world applied to the world in the story. This suggests that perceived similarity between a fictional world and reality influences how much we expect the worlds to overlap.

Weisberg and Goodstein (2009) were investigating the application of real world information to the world of a story, but a similar mechanism may operate when considering whether novel information within a story applies to the real world. If the fictional world and the real world are perceived to overlap in many of their details, then a reader can be more confident that novel information in the story is also true of the real world. This would explain children's decreased learning from fantasy contexts: A fantastical story is not perceived as similar to the real world and so information from the story is not transferred into reality. It could also explain the finding that children and adults learn false information from fiction; this represents an over-extension of the assumption that realistic fictional worlds are consistent with reality.

Summary. Children must draw some boundary between reality and fiction to avoid confusion about the true state of the world. However, information moves across the boundary from reality into fiction, and at least some information may move in the opposite direction.

Children are sensitive to a variety of factors when deciding whether novel information is real, including the immediate context and whether the information is possible given what they know about the world. Children's beliefs are also influenced by the source of the information. They are more likely to believe in fantastical entities that are endorsed by the adults in their culture, and they are more likely to learn from stories that contain realistic content. The apparent distance between a fictional world and the real one likely influences children's willingness to transfer information from it.

Learning via Analogy

The final step in learning new information from a fictional context is to appropriately apply it to the real world. Extrapolating a lesson learned in one area and applying it to another is learning by analogy. Analogical reasoning is a powerful tool in learning that makes our knowledge much more flexible and reduces the need for direct instruction; it is also likely to be an important component of learning from fictional sources, as the learning context differs in many ways from the context in which the information will be applied and used.

Holyoak (1984) outlined a four-step process for transferring problem-solving information from one context to another via analogical reasoning. First, learners must form a representation of both the source and target contexts. Second, they must realize the potential for an analogy. Third, they map some elements of the source onto corresponding elements of the target. Finally, they use this initial map to apply the problem-solving strategy to the target context.

Gentner's (1983) structure-mapping theory of analogy similarly focuses on forming a mapping between elements in two contexts, but also emphasizes the higher-order relations between elements. For example, when drawing an analogy between the solar system and the atom, a person must not only map the sun onto the nucleus and the planets onto the electrons, but

also must map the relations between these entities: The nucleus is more massive than the electrons just as the sun is more massive than the planets, and so the electrons and planets revolve around the nucleus and sun, respectively (Gentner & Toupin, 1986). Several different factors have been shown to influence the ease with which children can transfer information from one context to another. Each can be considered as affecting one particular step in the process outlined by Holyoak (1984).

Step 1: Forming a representation of source and target. For children to transfer a problem-solving strategy from one context to another, they must first understand it in the original context. If they are unable to do so, they will not be able to appropriately map it to the target context. Using the solar system/atom example from above, if a person mistakenly believes that the planets are more massive than the sun, then any analogy drawn to the structure of an atom will also be mistaken. To transfer a problem-solving strategy from one context to another, children must be able to understand the solution in the source context first. Young children's ability to solve a problem is influenced by their familiarity with the objects used and the relationships between them. For example, Crisafi and Brown (1986) taught 2-year-old children a goal-directed sequence of actions using either familiar objects and relations (retrieving a dime from a purse and inserting it into a gumball machine to get a gumball), familiar objects but unfamiliar relations (retrieving a dime from a milk carton and inserting it into a truck to get a gumball) or unfamiliar objects (retrieving a novel object from a drawer and putting it into an automated box to get a gumball). Children were most likely to correctly enact the sequence when the objects and relations were familiar. When considering analogical transfer, if unfamiliar objects or relations prevent children from forming an appropriate representation of the source, then the possibility for transfer will be disrupted.

Step 2: Detecting the possibility for analogy. Before children can begin to map the source information onto the target context, they must notice that the two situations are similar in important ways. If they do not detect the similarity, they will not move on to the next step of beginning to draw the analogical map. In the same study described in the previous section, Crisafi and Brown (1986) found that children were more likely to solve a problem if they were reminded that it was the same as one they had previously completed. Holyoak, Junn, and Billman (1984) found that transfer was disrupted when elements were added to the source story that had no counterpart in the target context, even if those elements were irrelevant to the problem itself (e. g., an extra character who was present during the problem but did not influence the solution in any way). The presence of this extra character may have reduced the likelihood that children would detect the similarity when they were later solving an analogous problem on their own.

Step 3: Mapping the source onto the target. Once children have noticed that the two contexts are similar, they must then to begin to find the specific correspondences between elements of the source and elements of the target. To illustrate, consider one problem that is often used in these studies: In the ball problem (Holyoak et al., 1984), children must move balls or marbles from one bowl to another that is out of reach. One solution is to roll up a piece of paper to use as a bridge between the containers and roll the marbles through it. When children heard a story about a genie who rolls up his magic carpet to move his jewels into a new bottle, they had to map the jewels onto the marbles, the genie's bottle onto the bowl, and the magic carpet onto the rolled paper.

Several studies have suggested that this mapping is easier when there is greater surface similarity between the two contexts. For example, Holyoak and colleagues (1984) found that the problem just described was more difficult for children than one in which they heard that the

genie used his staff to pull the new bottle closer, and children subsequently were provided with a cane to pull the bowl closer. The authors argued that the staff and cane were more similar to each other than the magic carpet and paper used in the other story, and that this surface similarity may have facilitated children's mapping. In another study, kindergartners were more likely to transfer a problem solution from one story to another when the stories had the same goal object, protagonist, or overall theme (Daehler & Chen, 1993). Having the same goal object was particularly influential, which leads to the next step in the process: applying the problem-solving strategy to the target context.

Step 4: Applying the strategy to the target. The final step is to use the mapping created in Step 3 to determine the appropriate way to apply the problem-solving strategy to the target. If children have successfully mapped all of the elements, they can then determine which action needs to be taken. In the ball problem, if children a) understood the strategy in the source of rolling up the carpet to move the marbles and b) have formed the mappings of jewels to marbles, genie's bottle to bowl, and magic carpet to paper, then they should realize that they can roll up the paper like the magic carpet and use it to move the marbles into the bowl. This requires attention to how the individual elements fit into the structure of the problem. Part of this is understanding the overall goal of the situation. Daehler and Chen (1993) showed that keeping the goal constant between source and target facilitated transfer. Similarly, children who spontaneously recalled the goal-structure of a problem during free recall, as well as children who were prompted to do so, show higher rates of transfer than children who do not recall the original goal (A. L. Brown, Kane, & Echols, 1986; Crisafi & Brown, 1986). When preschool children were asked to retell a story using a different set of characters, children correctly recalled more elements of the story using the correct characters when the story was systematic, that is when the

story contained a moral that explained the actions of the characters (Gentner & Toupin, 1986). These studies are consistent with the view that higher-order structure influences analogical transfer by constraining the possible ways elements can interact (Gentner, 1988).

Analogical transfer from fictional sources. Learning from fiction requires a type of analogical transfer. Children must form a representation of the novel information, generate a mapping from the fictional context to the real world, and then extrapolate the novel information and appropriately integrate it with their real-world knowledge. A few studies have looked directly at children's ability to solve problems after learning about an analogous solution in a fictional source. Richert and colleagues (Richert et al., 2009; Richert & Smith, 2011) read children stories in which a protagonist used a novel solution to solve a problem; for example, a teacher had more apples than she could carry and so wrapped them up in a blanket to bring them to her students. Children were later given an analogous problem to solve: They had to move marbles to the other side of the room and could use a towel to wrap them up and carry them. Across several studies, preschool children were more likely to apply the solution from the story to the analogous problem when the source story was realistic (as in the teacher example above) than when the source story was fantastical.

In my own work (Hopkins & Lillard, 2014), we have investigated whether there are specific elements of fantasy that influence transfer more than others. Based on the research reviewed in this section, we identified several factors common to fantasy stories that could interfere with the process of analogical transfer: setting the story on a fictional planet, using illustrations that are dissimilar to the real world, including fantasy creatures like dragons, and incorporating violations of physical causality. Using a procedure based on Richert and Smith (2011), children were read a story in which a character solved a novel problem (rolled a

magazine into a tube to move dog food into an out-of-reach bowl). Children were then given an analogous problem to solve on their own (moving marbles into a bowl that was out of reach inside a large box). We created a set of custom storybooks that varied the aforementioned factors one at a time to investigate the individual effects of each on the likelihood that children would transfer the problem solution.

The only variable that led to a decrease in transfer was unrealistic illustrations, although the effect was not statistically significant. The perceptual dissimilarity between the story and the real world could interfere with steps 2 and 3 of transfer, making it more difficult for children to detect the similarity between source and target contexts and/or increasing the difficulty of mapping elements of the source onto elements of the target. Contrary to our expectations, the presence of causal violations (the protagonist could fly and walk through walls) increased the likelihood that children would transfer the problem solution. Children who read the causal violations story did not show greater memory for the story events, so it is unlikely that the increase in transfer is due to more interest in or better attention to the story. Rather, the causal violations may have been especially salient and primed children to consider the possibility of subsequent events in the story, leading to more careful consideration of the problem solution. Supporting this interpretation, children in the causal violations condition were more likely to spontaneously describe the problem when asked to recall the events of the story, and there was no positive effect of the causal violations if they occurred after the problem solution.

Transfer from Pretense

Thus far, we have seen that children can learn new information from stories, including novel object labels (Ganea et al., 2008), biological information (Ganea et al., 2011; Kelemen et al., 2014), and problem-solving strategies (Hopkins & Lillard, 2014; Richert et al., 2009; Richert

& Smith, 2011); learning is generally greater when the stories are realistic than when they are unrealistic, cartoonish, or fantastical. However, stories are not the only type of fictional world with which children engage, and relatively few studies have looked at transfer of information from pretend play, another form of fiction that is prevalent in the lives of young children. There are several reasons to believe that, like stories, children would treat pretend play as a fictional world that is a potential source of information about reality.

First, just as children seem to draw boundaries around fictional worlds, they also keep pretend worlds separate from each other and from reality. Children can keep track of multiple identities of an object across different pretend scenarios; for example, if a block is used as food in one pretend game and as soap in another pretend game, children remember this and act on the object appropriately depending on which situation they are in (Wyman, Rakoczy, & Tomasello, 2010). They also resist moving objects from one pretend scenario to another; having pretended that a block is a bar of soap in one pretend game, they do not retrieve that object when a character in a different game needs soap (Weisberg & Bloom, 2009). These studies suggest that children represent multiple pretend worlds as separate from each other, similar to how they represent fictional worlds in stories.

Children also represent pretend worlds as separate from reality. They recognize that a person who was not present during a pretend episode will not automatically share in the pretense (Hickling, Wellman, & Gottfried, 1997; Woolley & Phelps, 1994; Wyman, Rakoczy, & Tomasello, 2009). For example, if children pretend with one experimenter that a box contains scissors, they do not give that box to another experimenter who was not present during the pretense when that second experimenter asks for scissors (Woolley & Phelps, 1994).

The few studies that have looked at learning new information from pretense suggest that children can learn some novel information, at least from fairly simple pretend scenarios. In a series of studies, Sutherland and Friedman (2012; 2013) showed that children learned information about a novel animal from a simple pretend scenario involving puppets. Children were shown a puppet that was introduced as a "nerp"; they then saw a puppet show including information about the nerp's preferences. For example, the nerp pretended to eat and enjoy an apple and pretended to be scared of a frog. After the pretend episode, children were shown pictures of an unfamiliar animal that was labeled a nerp; they were asked questions about the nerp's preferences. Children answered correctly about 80% of the time when the questions were forced-choice and about 50% of the time when the questions were open-ended.

As discussed earlier, Hopkins et al. (2014) found that children could learn novel object labels and functions that were presented in a pretend context. Additionally, children used properties of the pretend scenario (specifically, the substitute object used to represent the novel object) to make inferences about the properties of the novel object; children showed a bias to assume that the novel object would be similar in appearance to the substitute that had been used to represent it.

These studies have several important implications. First and most important, it is possible for children to learn new information from a pretend context. Framing the learning context as pretend did not cause children to completely quarantine the novel information. Second, children treat information learned in a pretend context differently than information learned in a real context. They did not simply absorb the new information into their existing concepts of reality; rather, they used the context and the properties of the information to construct a representation of the novel object.

However, a limitation of these studies is that the situations differed in many ways from natural pretend play, making it difficult to generalize to children's everyday experiences. The situations were very simple, highly controlled, and somewhat pedagogical; the child was mostly a passive viewer while the experimenter presented new pieces of information to them. Additionally, the information was completely realistic, which could have led to an overestimation of children's likelihood to learn from pretense. On the other hand, the lack of active participation on the part of the child might have decreased their motivation and engagement, leading to less learning. In order to evaluate the potential for pretend play and fantasy to be used in educational settings, a more naturalistic examination of learning novel information from pretend play is needed.

Current Study

The goal of this study was to extend existing work on children's learning of novel information from pretense in three key ways. The first was to investigate the efficacy of pretense as a learning context by comparing learning from a semi-naturalistic episode of pretense to learning from a matched, non-pretend activity. The only study I am aware of that has directly compared learning from pretense and reality thus far is my own (Hopkins et al., 2014). We found that children processed the same novel information differently depending on whether it was presented in a real or pretend context. Children who learned a novel object label in a pretend context were more likely to infer that the novel object would be similar in appearance to the substitute used to represent it during the pretense as compared to children who learned the label in a real context. This suggests that learning from pretense may be a constructive process, where the learning context is taken into account when processing new information.

However, the observed differences in the previous study between learning from pretense and learning from reality were qualitative, not quantitative. The findings do not tell us anything about the relative efficacy of using pretend play to teach novel information over other methods of instruction. Considering that pretense and fantasy are often incorporated into educational materials, what is needed is a more direct comparison between learning during pretend play and a comparable, non-pretend method of instruction. It is possible that learning from pretend play will be more effective because children are highly motivated to pretend or are more engaged in pretending than in other activities. On the other hand, children may be less likely to learn from pretense because of difficulties in moving information across the pretend-reality boundary.

The second aim of the current study was to examine the effect of fantasy content on learning from pretense. Previous research has shown that fantasy content affects children's learning from other types of fiction, but this has not been shown with pretend play. Additionally, these studies on learning from stories have almost exclusively compared highly fantastical stories to completely realistic stories, with the exception of my own work (Hopkins & Lillard, 2014). We do not know whether modulating the distance from reality would affect children's learning. This study involved a real, non-pretend activity as well as both a realistic and a fantastical pretend activity. If distance from reality is an important predictor of transfer, then the real condition should show more transfer than the realistic pretense condition, which in turn should show more transfer than the fantastical pretense condition.

Finally, this study investigated other potential predictors of children's analogical transfer: memory for the play activity, engagement in the play activity, fantasy orientation, and ability to discriminate fantasy from reality. It has been argued that fantasy and pretense are effective as teaching tools because they increase intrinsic motivation (Cordova & Lepper, 1996; Parker &

Lepper, 1992); if this is true, we would expect children in the pretense conditions to show more engagement in the activity than children participating in the non-pretend condition. They may also show greater memory for the activity. In turn, engagement and memory may predict transfer from the pretense activity.

Children's attitude towards and understanding of fantasy could also predict children's transfer. Fantasy orientation has been related to transfer in several studies, although the results are not consistent. In some cases, higher fantasy orientation predicted greater movement of information across the fantasy/reality boundary (Boerger, Tullos, & Woolley, 2009; Woolley et al., 2004), suggesting that children who engage with fantasy frequently may blur the lines between fantasy and reality: for example, children with higher fantasy orientation were more likely to believe in a novel fantasy character (Boerger et al., 2009; Woolley et al., 2004). In other studies, however, higher fantasy orientation has predicted better fantasy/reality discrimination (Sharon & Woolley, 2004) and less transfer from fantasy contexts (Richert & Smith, 2011), suggesting that children who engage with fantasy frequently are more practiced at maintaining the boundary between pretense and reality.

Method

Participants

Participants were 61 children (32 girls) between 48 and 72 months (M = 59.53 months; SD = 7.15 months). This age group is appropriate for this study because it is considered the "high season" of pretend play (D. G. Singer & Singer, 1990). Additionally, it overlaps with the age ranges typically used in research on children's learning from fiction and pretense, allowing for comparisons to previous findings. Children were recruited from the local area, and the race and ethnic composition of the sample reflected the demographics of the community: 61.3% identified

as white, 1.6% as black or African-American, 3.2% as Asian, 3.2% as Hispanic, 9.7% as more than one race, and 21.0% did not report. Parents were also asked to report their highest degree of education: 56% of mothers had a post-graduate degree, 36% had a college degree, 5% had a high school diploma, and 3% did not report.

Procedure

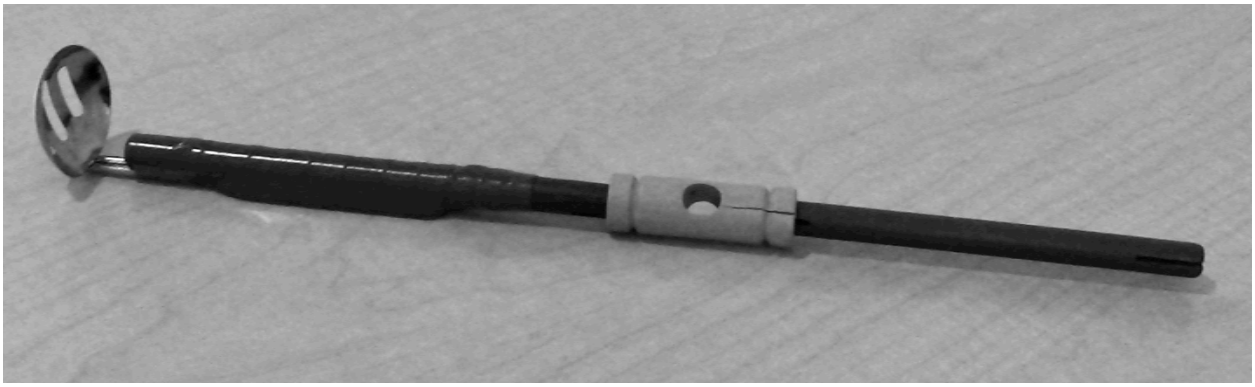
Each child was pseudo-randomly assigned to one of three conditions (real, realistic pretense, and fantasy pretense), balanced for gender and age. Children were tested individually in a quiet room with a single experimenter. Each child participated in a short play period, followed by a post-test.

Play period. The play period was divided into two activities (building and painting), each of which involved the presentation of a novel object label and problem-solving strategy. The experimenter engaged with children during the activity, encouraging them to be active participants. The exact details of the activities differed across conditions although the overall structure of the play session was the same. Scripts for the play period of each condition are included in Appendix A. The play period lasted on average 7.8 minutes (*SD* = 1.78 minutes; Range = 5.2–11.9 minutes). Each participant was videotaped, and trained research assistants coded the play period for children's level of engagement on a scale from 1 (not at all engaged) to 5 (highly engaged). For reliability, 20% of the videos were coded by a second rater. Inter-rater agreement was very high. The two coders' ratings were highly correlated (r = .95); ratings matched for 90% of the double-coded videos, and they never differed by more than 1 point.

Real condition (n = 20). In the real condition, children participated in two activities: building with blocks and painting a picture. During the blocks activity, the experimenter suggested different things to do with the blocks, such as building a tall tower and making

different shapes and letters. After a few minutes of playing, the problem was introduced: a block fell off of the table and could not be reached while remaining seated. The experimenter showed children how to attach a spoon to a stick using a connector and used the resulting tool to retrieve the block (Figure 1a). While doing this, the experimenter provided a novel label and description for the tool: “We can build a surnit. Surnits have long handles to help you get things you can’t reach”. After watching the experimenter, children were given the opportunity to assemble a surnit and retrieve the object for themselves.

a)



b)

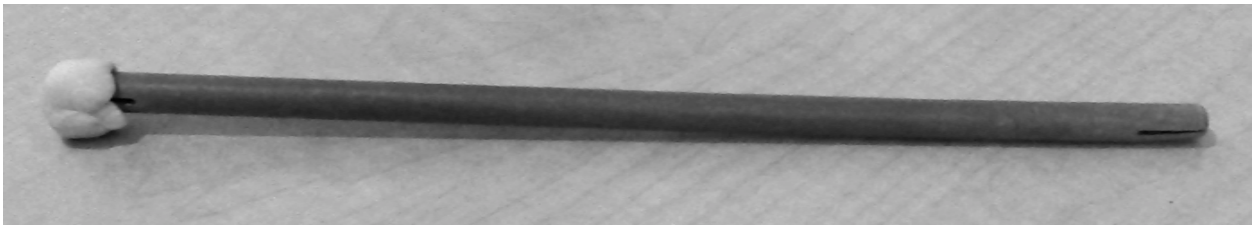


Figure 1. The novel tools used during the blocks (a) and painting (b) activities.

The painting activity proceeded in a similar fashion; the experimenter began by engaging children in painting a picture with watercolors, asking for suggestions on what to include and discussing different components of the painting. The problem-solving task involved retrieving a small stone to use for painting dots from the bottom of a cup of water. The solution was to build

a “tulver” by affixing sticky tack to the end of a long stick and using it to retrieve the stone (Figure 1b). As in the blocks activity, the experimenter stated the name and function of the novel tool: “We can build a tulver. Tulvers are sticky on the end to help you pick things up”. Children were again given the opportunity to try building the novel object and solving the problem for themselves.

Realistic pretend condition (n = 21). The overall structure of this condition was very similar to the real condition, except that children pretended to build a house and paint a picture instead of doing the activities for real. During the block activity, the experimenter and child pretended to be builders building a house with the blocks. The experimenter suggested different activities, such as building the walls of the house, painting the house, building a swimming pool in the yard, and taking a break to eat lunch. The problem-solving strategy was the same as in the real condition, except that the experimenter pretended that the block to be retrieved was a lunchbox that had fallen into a deep hole. The experimenter still constructed the problem-solving implement and retrieved the object, allowing children to do so as well.

Similarly, during the painting activity, the experimenter and children pretended to be artists, using paintbrushes to pretend to paint pictures. They pretended to do the same types of actions that children in the real condition actually performed. The object to be retrieved during the problem-solving task was a small foam block that the experimenter pretended was a sponge that could be used to paint with.

Fantastical pretend condition (n = 20). This condition proceeded in the same manner as the realistic pretend condition, except that the children and the experimenter pretended to be fairies building a castle and wizards using magic wands. The same novel tools were created to solve the novel problems, but the framing of the problems differed. During the block activity, the

experimenter pretended that the block was a crystal ball that had fallen off of the castle tower. During the paint activity, the foam block was a magic stone that could be used to bring the wizards' creations to life.

Post-test. After the play period, the experimenter explained that the game was over and the toys were put away before beginning the post-test.

Analogous problem-solving task. To assess whether children learned the problem-solving strategy from the play phase, they were given an analogous problem to solve. The experimenter told children to retrieve a ball from a tall jar with a narrow opening at the top. Children were told that it was against the rules to put their hands inside the jar or to turn it over to retrieve the ball. They were given a variety of objects they could use to retrieve the ball, including the problem-solving materials from the play phase (sticks, connector, spoon, sticky tack) and several distracter items (paper clips, string, wooden spool, rubber bands; see Figure 2).

Children were given 4 minutes to solve the problem on their own, during which time the experimenter gave only generic feedback, such as, "That didn't work" or "What else can you try?". If a child generated a correct solution, the experimenter took those materials away, put the ball back in the jar, and asked the child to find another way to solve the problem. If after 4 minutes the child had not generated both of the solutions, the experimenter provided a hint: "Can you remember anything from the games we played earlier that could help here?". Children were then given another 2 minutes to solve the problem. If a child had not retrieved the ball after those 2 minutes, the experimenter gave whatever hints necessary to guide the child to a correct solution before proceeding to the next part of the procedure. For each solution, children were given 2 points if they generated it in the first 4 minutes, 1 point if they generated it after receiving the

hint, and 0 points if they did not generate the solution during the 6 minutes; summing across both solutions resulted in a possible solution transfer score from 0–4.

Figure 2. Objects used during the analogous problem-solving task.

Reality judgment. To assess whether children learned the novel object categories they were taught during the play phase, a reality judgment task was administered following the transfer task. Children were asked to judge 8 familiar items – 4 real (builder, artist, hammer, and paintbrush) and 4 fantastical (wizard, fairy, magic wand, and crystal ball) – as well as the two novel objects from the play period (surnit and tulver). A color drawing of each object was printed on a 4” x 6” index card. The experimenter began the task by explaining that children had to decide whether each picture they saw was of an object that was real or one that was not real; pictures of a dog and a purple cow were used as examples of each category. The experimenter then showed children the target pictures one at a time, and asked them to label the picture and describe the item (“What do artists do?” or “What are hammers for?”) before judging whether it

was real or not real. Cards were sorted into two piles according to children's reality judgments. Coders recorded reality judgments for each item as well as whether children correctly stated the function of the two novel objects when asked to describe them.

After providing reality judgments for all 10 objects, children were asked to provide confidence ratings for their judgments. A three-point confidence scale was used ("very sure", "a little sure", or "not sure"). The experimenter explained the scale to the child as follows: "I want to ask you how sure you are of the things you said before. Sometimes you definitely know something, and then you say you're very sure about it. Sometimes you think you know, but you're just a little sure. Other times, you just don't know and then you say you're not sure". The words "very sure", "a little sure", and "not sure" were printed on a piece of paper, and the experimenter pointed to each as she explained the scale. For each item, the experimenter held up the picture, reminded children of their reality judgment ("You said that builders are real") and then asked how confident they were ("Are you very sure, a little sure, or not sure?") while pointing to the words for each option. Reality judgments and confidence ratings were combined to give a score for each item from -3 to 3, with -3 representing a response of "not real" with a "very sure" confidence rating and 3 representing a response of "real" with a "very sure" confidence rating.

Two variables were generated from this task. The first was a measure of whether children believed the novel objects to be real. Because children differed in how they used the confidence scale, each child's average rating of the novel objects was scaled relative to how they rated the familiar objects. For each child, the average confidence rating for the items that he or she said were real was set to 1, and their average rating for the items he or she said were not real was set to 0; their average rating for the novel items was then adjusted according to this scale. Using this

method, a score of 1 indicates that the novel objects were rated the same as how the child rated other objects that he or she believed to be real, and a score of 0 indicates the novel objects were rated the same as how the child rated other objects he or she believed were not real. Scores could not be computed for 5 children who said that all of the familiar items were real; their data was not included in any analyses involving this variable.

The second variable coded from performance on this task was a measure of how much children discriminated real from fantasy items. Each child's average rating of the fantasy items (wizard, fairy, wand, crystal ball) was subtracted from his or her average rating of the real items (builder, artist, hammer, paintbrush). The maximum possible score on this variable is 6, indicating that a child said that he or she was very sure that all the real items were real and that very sure that all the fantasy items were not real[1]. Smaller scores indicate less discrimination of the two categories. This variable is of interest because children's understanding of the difference between fantasy and reality could predict the likelihood that they transfer information across the fantasy/reality boundary.

Memory. Finally, children's memory for the play period was assessed. First, children were introduced to a stuffed elephant named Sam and asked to tell Sam as much as they could remember of the two activities from the play period. The experimenter used a series of prompts ("What else did you do?", "What happened next?", "Can you remember anything else?") to encourage children to remember as much as they could. Free recall was coded for how many discrete elements of the play period were recalled by each child. Free recall score was computed as the number of incorrect details recalled subtracted from the number of correct details. Following the free recall measure, the experimenter asked 9 direct questions about specific

[1] One child had a large, negative score on this measure (-1.75), indicating that she rated the fantasy items as more real than the real items. The exclusion of this data point did not change any results.

details of the play period (Appendix B). Children received a score for the direct questions representing how many they answered correctly.

Parent measures. Parents were asked to complete a questionnaire assessing their child's fantasy orientation (Tullos, 2009). Two items from this questionnaire were used. The first was an overall assessment of the child's interest in fantasy using a 5-item scale: 1 = "child strongly interested in reality"; 2 = "sometimes child is interested in fantasy, but mostly interested in reality"; 3 = "child is equally interested in fantastical and reality play/media"; 4 = "child is mostly interested in fantasy, but sometimes interested in reality"; 5 = "child is strongly interested in fantasy". Second, parents indicated whether their child believed in three event-related entities whose existence is typically endorsed by adults: Santa Claus, the Easter Bunny, and the Tooth Fairy. For each entity, responses were scored as 1 if the parent said their child believed the entity was real, .5 if the parent said their child's belief was unknown, and 0 if parents said their child believed the entity was pretend. Items were them summed to create a possible score of 0 – 3, with higher scores representing belief in more of the fantasy entities.

Results

This study addressed children's transfer of two types of information: novel problem solutions and novel object information. Solution transfer was assessed by whether children generated the novel problem solutions during the analogous problem solving task. Object transfer was assessed in two ways: whether children recalled the functions of the novel objects and whether they judged the novel object categories to be real. Additionally, there were 11 variables that might predict transfer: age, gender, maternal education, parent report of belief in fantasy entities, parent rating of fantasy orientation, child's fantasy/reality discrimination, free recall of the play period, direct memory questions, engagement, length of the play period, and

condition. First, condition differences for predictors and transfer variables were investigated. Second, linear regressions were conducted for each transfer measure to determine which variables significantly predicted transfer.

Condition Differences

Descriptive data for predictors are reported in Table 1. There were no a priori differences among the conditions for age or mother's education. The length of the play period in the real condition was significantly longer than the realistic pretense condition, $t(39) = 7.54$, $p < .001$, $d = 2.42$, and the fantasy pretense condition, $t(39) = 8.56$, $p < .001$, $d = 2.78$. This was primarily due to the additional time needed to set up and clean up the painting activity. The realistic pretense and fantasy pretense conditions did not differ significantly from each other. Play period length was included as a control in all other analyses to ensure that any potential condition differences were not due to more or less time spent involved in the play.

Among the remaining predictors, only responses to the direct memory questions and engagement differed significantly among conditions. Average memory score in the fantasy pretense condition was significantly lower than both the realistic pretense condition, $t(39) = 2.76$, $p < .01$, $d = 0.88$, and the real condition, $t(38) = 2.35$, $p < .05$, $d = 0.76$; the real and realistic pretense conditions were not significantly different from each other. Both effects remained significant in a linear regression after controlling for age, mother's education, and play length: $F(5, 53) = 2.43$, $p < .05$, model $R^2 = 0.17$. The overall effect of condition accounted for 18% of the variance in memory scores.

Similarly, engagement in the fantasy pretense condition was significantly lower than both the realistic pretense condition, $t(39) = 2.70$, $p < .05$, $d = 0.86$, and the real condition, $t(38) = 3.11$, $p < .01$, $d = 1.01$; the real and realistic pretense conditions were not significantly different

from each other. Only the difference between the fantasy and realistic pretense conditions remained significant in a linear regression controlling for age, mother's education, and play length: $F(5, 53) = 2.79$, $p < .05$, model $R^2 = .21$. The overall effect of condition accounted for 10% of the variance in engagement.

Table 1

Descriptive Data by Condition for Predictor Variables

Predictor Variable	Fantasy Pretense	Realistic Pretense	Real
Age - in months (Range = 48.6–71.9)	59.38 (7.25)	59.94 (7.19)	59.25 (7.35)
Mother's education (Range = 2–4)	3.60 (0.50)	3.45 (0.69)	3.53 (0.61)
Play period length – in seconds* (Range = 314–714)	405.10 (61.83)	419.86 (69.91)	587.70 (72.62)
Belief in fantasy entities – parent report (Range = 0.5–3)	2.58 (0.63)	2.52 (0.70)	2.45 (0.67)
Fantasy orientation – parent rating (Range = 1–5)	3.05 (0.94)	2.76 (0.94)	3.21 (0.98)
Fantasy/reality discrimination (Range = -1.75–6.00)	3.33 (2.05)	2.68 (1.55)	2.83 (2.02)
Memory – free recall (Range = 0–11)	3.65 (2.60)	4.71 (2.47)	4.90 (1.55)
Memory – direct questions* (Range = 2–9)	5.90 (1.77)	7.43 (1.78)	7.05 (1.28)
Engagement* (Range = 1–5)	2.55 (0.94)	3.33 (0.91)	3.45 (0.89)

Note. Table presents mean values for each variable by condition. Standard deviations are in parentheses.
* Statistically significant difference between conditions

Means by condition for each transfer variable are reported in Table 2. There were no significant effects of condition on any of the transfer measures. Neither pretense nor fantasy content influenced children's transfer of the novel problem solutions or the novel object information relative to the real condition.

Table 2

Descriptive Data by Condition for Transfer Measures

Transfer Measure	Fantasy Pretense	Realistic Pretense	Real
Solution transfer score (out of 4)	2.90 (1.45)	2.62 (1.63)	2.90 (1.52)
Novel function recall (out of 2)	1.45 (0.76)	1.71 (0.56)	1.65 (0.59)
Scaled reality judgment (Range = -0.25 – 1.08)	0.71 (0.46)	0.57 (0.51)	0.76 (0.37)

Note. Table presents mean scores for each variable by condition. Standard deviations are in parentheses.

Predictors of Transfer

Correlations among predictor variables are reported in Table 3. Adjusting for multiple comparisons, the only significant correlation was between the two memory measures (r = .49). There was little intercorrelation among the fantasy measures; parent report of belief and fantasy/reality discrimination were moderately correlated (r = .25, p = .05), but this was not significant after correcting for multiple comparisons.

Next, linear regressions were fitted for each transfer variable separately to assess the potential effects of the predictor variables. Each regression controlled for the effects of age,

mother's education, and length of the play period to ensure that effects were not due to general cognitive ability, socioeconomic status, or longer engagement with the play.

Table 3

Correlations Among Predictor Variables

	1.	2.	3.	4.	5.	6.	7.
1. Age							
2. Mother's education	.04						
3. Belief in fantasy entities	.10	.09					
4. Fantasy orientation	-.17	.37[a]	.13				
5. Fantasy discrimination	.21	.20	.25[a]	-.07			
6. Memory – free recall	.28[a]	.04	.02	-.08	.06		
7. Memory – direct questions	.06	.06	-.06	.04	.10	.49[b]	
8. Engagement	.18	.07	.14	-.12	.01	.38[a]	.12

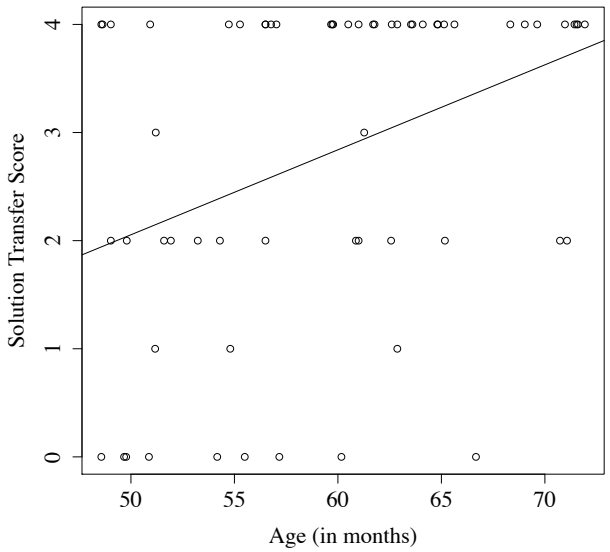
[a] Significant at $\alpha = .05$
[b] Significant at $\alpha = .002$ (Bonferroni correction for multiple comparisons)

Solution transfer. The first variable assessing transfer from the play period was whether children generated the novel solutions during the analogous problem-solving task. Most children (85.2%) transferred at least one solution; 55.7% of children received the maximum score of 4, meaning that they generated both solutions before receiving a hint to think about the play period.

There was a significant, positive effect of age on solution transfer scores: Older children scored higher on this measure than younger children (Figure 3a). There was also a marginal, positive effect of fantasy/reality discrimination (Figure 3b) in a linear regression controlling for age, maternal education, and length of play period (Table 4): Children who made a stronger distinction between reality and fantasy items were more likely to employ the novel solutions

during the transfer task. There were no significant effects of gender, memory (free recall or direct questions), engagement, or fantasy orientation (belief or parent rating) on children's solution transfer scores.

a)



b)

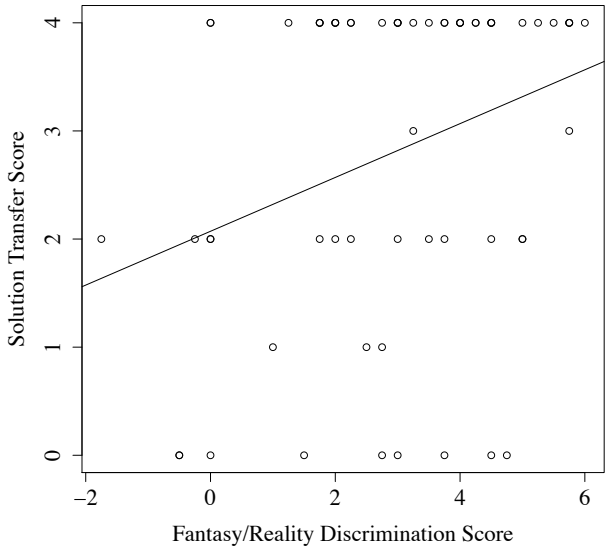


Figure 3. The effect of (a) age and (b) fantasy/reality discrimination on transfer of problem solutions.

Table 4

Linear Regression Predicting Solution Transfer Scores

Predictor	β	*SE*	*p*	Δ R^2
Intercept	-1.76	2.27	.44	
Age	0.06	0.03	< .05	0.14
Mother's education	0.24	0.32	.46	0.01
Length of play period	0.00	0.00	.57	0.00
Reality/fantasy discrimination	0.19	0.10	.08	0.05

$F(4, 54) = 3.38$, $p < .01$, $R^2 = .20$

Object transfer. Two measures assessed children's transfer of information about the novel objects (surnits and tulvers). The first was whether children correctly stated the novel objects' functions when asked what surnits or tulvers are for. Most children (91.8%) correctly recalled at least one function; 68.9% correctly recalled both. No other variables predicted children's recall of the novel functions.

The second assessment was whether children believed that the novel objects were real; the majority of children (80.3%) stated that at least one of the object categories was real. The scaled reality judgment score described in the Procedure adjusted children's ratings of the novel objects relative to their judgments of the familiar entities. Recall that a score of 0 indicates that children rated the novel items the same as the other items they judged as not real; a score of 1 indicates that children rated the novel items the same as the other items they judged as real.

As with solution transfer, there was a significant, positive effect of age on scaled reality judgments (Figure 4a): Older children judged the novel objects as real more so than younger children. There were also significant effects of reality/fantasy discrimination and parent report of

belief in endorsed entities on children's scaled judgments of the novel objects in a linear regression controlling for age, maternal education, and length of the play period (Table 5). Children who made a stronger distinction between reality and fantasy items were more likely to rate the novel items as real (Figure 4b), and children whose parents reported greater belief in endorsed entities were less likely to rate the novel items as real. In effect, both results show that children who exhibited *less* fantasy/reality confusion were *more* likely to rate the novel entities as real. Discrimination scores and belief in endorsed entities were marginally correlated ($r = .25$, $p = .05$), but each explained unique variance in judgments of the novel objects (12% and 9% respectively). There were no significant effects of gender, memory (free recall or direct questions), engagement, or parent rating of fantasy orientation on reality judgments.

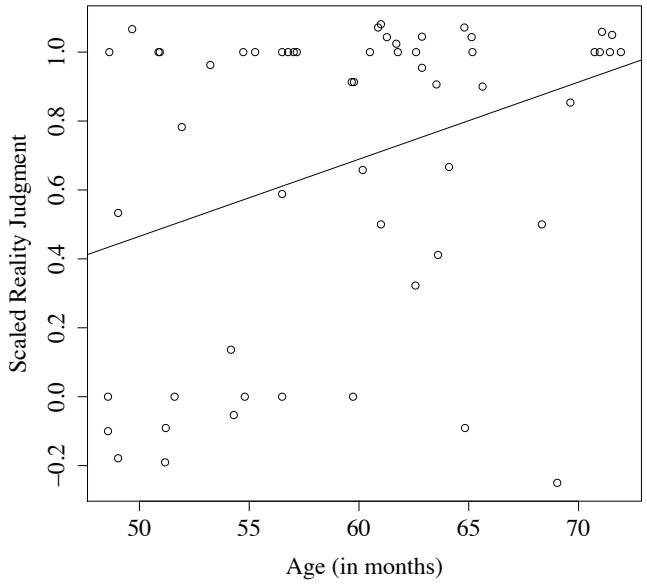
Table 5

Linear Regression Predicting Scaled Reality Judgments of Novel Objects

Predictor	β	*SE*	*p*	Δ R^2
Intercept	-0.17	0.65	.80	
Age	0.02	0.01	< .05	0.12
Mother's education	-0.08	0.10	.42	0.00
Length of play period	0.00	0.00	.57	0.01
Reality/fantasy discrimination	0.10	0.03	< .01	0.12
Belief in endorsed entities	-0.23	0.09	< .05	0.09

$F(5, 48) = 5.08$, $p < .001$, $R^2 = .35$

a)



b)

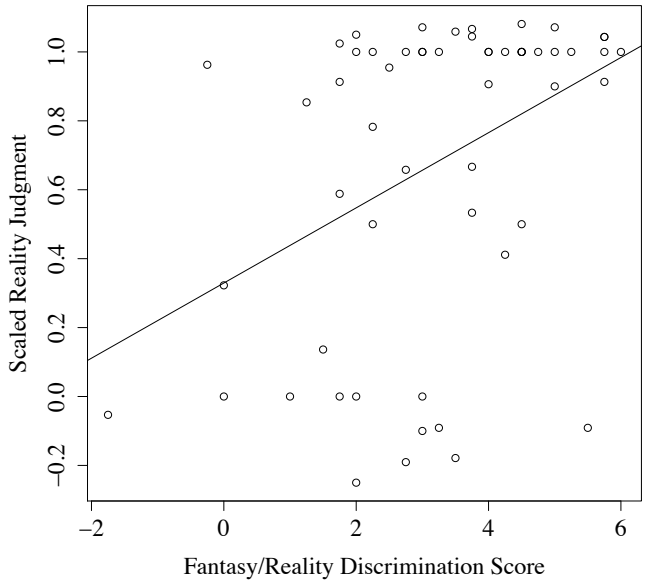


Figure 4. The effect of (a) age and (b) fantasy/reality discrimination on reality judgments of the novel objects.

Discussion

The study presented here had three primary aims. The first was to investigate learning from a semi-naturalistic episode of pretend play and compare this to learning from a matched, non-pretend activity. The second was to investigate the effect of fantasy on children's learning from play, and the third was to consider other factors that could predict children's transfer of information from a play episode. Results related to these three aims will discussed in turn.

Learning from Pretense vs. Reality

Children in this study showed fairly high rates of learning from a pretend episode – the majority of children transferred the novel problem solutions from the pretend episode to an analogous context, recalled the functions of novel objects, and judged those novel objects to be real. There were no condition differences on any transfer measures, suggesting that – at least in the way it was implemented here – pretend play did not have an effect on children's learning in either the positive or negative direction. Even though children generally draw boundaries between pretense and reality, they can learn some types of information from pretend play and this learning does not differ from learning during a non-pretense activity.

In the Introduction, I outlined a process for learning from fictional contexts. Children must evaluate the plausibility of the information itself, as well as the reliability of the source. The information must then be transferred across the fiction/reality boundary and applied to a new context via analogical reasoning. The information taught in this study was realistic, and did not have any of the properties shown in previous studies to affect children's reality judgments. Surnits and tulvers were defined in realistic ways ("surnits help you get things you can't reach"), and they did not violate any physical rules. Because of this, children may have judged the information as real, even when it was presented in a pretend or fantasy context. This suggests

that a pretend frame does not cause children to completely quarantine all information; realistic information may be allowed to move across the boundary.

Having decided that the novel information was real, children then had to apply it to the analogous test situations. As outlined in the Introduction, this involves detecting the similarities between the source and target contexts, mapping elements of the source onto elements of the target, and appropriately extrapolating the new information. The objects used during the play and test phases were very similar, making the first two steps of this process relatively easy for children in this study. Additionally, in all conditions, the novel object was present during the play period and children were able to use it to solve the problem. This active experience could have benefited children's detection of the possibility for analogy and their extrapolation of the solution to the target problem. Having previously enacted the solution would make it cognitively available to them when confronted with the analogous problem; both children and adults show better memory when they have enacted something with their bodies (Marbach & Yawkey, 1980; Scott, Harris, & Rothe, 2001). Future work could vary whether children have the opportunity to enact a solution or only observe it during a play period to test this prediction.

The results of the current study suggest that a pretend context could be used to teach children realistic information about objects if the physical objects are present and children are allowed to use them. However, the effect of pretense may vary depending on the type of pretense and the type of information being taught. Hopkins et al. (2014) showed that the use of substitute objects in pretense influenced the inferences that children drew about novel object categories. They did still learn the novel objects' functions, but the substitutes influenced children's assumptions about the appearance of the novel objects. The use of substitutes must be carefully considered to ensure that children are making the correct assumptions about real objects.

Furthermore, part of the potential utility of pretense as an educational tool is that children can pretend about things that are foreign to their everyday experience. For example, children cannot learn about outer space via direct experience, but they can pretend to be astronauts exploring distant planets. Pretend play could serve as tool to give children first-hand experience with people, places, and locations they would not normally experience for themselves. Future work should investigate how pretend play influences learning of this type of information. On the one hand, the counterfactual nature of pretend play makes it particularly suited for considering unusual or unfamiliar contexts. On the other hand, it may be harder for children to separate the real information from the pretense when the context is less familiar.

Regarding the argument for increased pretend play in early educational settings, these results are somewhat inconclusive. On the one hand, this type of pretending did not harm children's learning: Children in the pretend conditions were just as likely to learn the novel information as children in the real condition. On the other, there was no evidence for a positive effect of pretending on learning. There were no condition differences in transfer of either the novel problem solutions or the novel object information. Children in the pretend condition were not more engaged than children in the real condition, and they did not show better memory for the play period. These findings do not support the argument that pretend play has a positive effect on learning, but neither do they directly contradict it. Differences between pretense and real learning may have emerged with a more difficult learning measure; although performance here was not at ceiling, the relatively high rates of transfer might have masked potential benefits of either pretend or real contexts for learning.

The Impact of Fantasy on Learning

The second aim of this study was to investigate the effect of fantasy themes on learning from pretense. Previous work has consistently found that children are less likely to transfer information from fantastical stories than from realistic stories (Ganea et al., 2014; Richert et al., 2009; Richert & Smith, 2011; Walker et al., 2012). In contrast, there was no effect of fantasy on transfer of either problem solutions or novel object information in the current study. However, children in the fantasy condition were less engaged in the activity and had poorer memory for the play period than children in the realistic pretense and real conditions. It is possible that condition effects on transfer would have emerged after a delay or that children in the fantasy condition would retain the information for less time than children in the other conditions.

There are several possible explanations for why the effect of fantasy observed in storybooks did not replicate here with pretense. The first, as discussed in the previous section, is that the nature of the information in this study overrode any potential context effects: Children transferred the information because it seemed realistic, even if it came from a fantastical context. Additionally, the opportunity to act out the solutions during the play period is an important difference between learning from pretense and stories; stories are relatively passive, while pretending and other forms of play generally entail active involvement of the whole body. This more active nature could make learning from play more robust to the effect of fantasy than learning from stories. Although it is difficult to compare across studies with different methods, performance on the transfer task in all conditions of the current study was comparable to rates of transfer from the realistic stories in Richert et al. (2009) and Richert and Smith (2011), suggesting that children in the current study were less affected by the fantasy context. A direct comparison of stories and pretense using the same content, fantasy themes, and assessments of

transfer is needed to better understand the relative efficacy of the two types of media for instructional purposes.

Another possible explanation is that the fantasy content used in this study was less salient than in studies of storybooks. The fantasy here was imagined, as opposed to visible in illustrations. Previous work on analogical transfer (Daehler & Chen, 1993; Holyoak et al., 1984) has suggested that surface dissimilarity between source and target contexts interferes with children's ability to transfer across them. If perceptual dissimilarity is partly driving the effect found in previous work, it could explain why the negative impact of fantasy did not replicate here. The physical properties of the play period were very similar to the transfer context; the differences were all imagined. If the imagined context was less salient to children than the physical properties, there would have been less interference with the analogical mapping process from the fantasy frame. Fantasy play involving unrealistic costumes and props could impede transfer more so than the imagined fantasy content used here.

More generally, the inconsistent results across studies imply that it may not be fruitful to consider only the global effect of fantasy or pretense on learning. If children's learning from pretense and other fictional worlds is a process of evaluating both the information itself as well as the source, then results will vary to the extent that studies involve different types of fictional worlds and different types of information. There are two interesting possible effects to consider. First, some types of information may be more or less affected by fantasy. Second, the type of fantasy and the type of information may interact, such that the same fantasy property will have a different effect depending on what type of information is being taught.

Domain-specific effects. Some types of information may be less affected by fantasy than others. Weisberg and Goodstein (2009) found that adults had domain-specific intuitions about

whether real-world facts would hold true in the world of a story. They tended to say that mathematical facts ("2 + 2 = 4") would be true even in highly fantastical stories, but that contingent facts ("Washington, DC is the capital of the United States") would be true only in realistic stories. This suggests that some types of information are viewed by adults as more universal and likely to be true in any fictional world. It is an open question whether children have similar intuitions, but if they do, then we might expect learning of fundamental information, like math, to be less affected by context than learning of other types of information. This is consistent with the finding of the current study that the effect of fantasy/reality discrimination was stronger for the object reality judgments than for the problem-solving task. Object affordances in problem solving may be more fundamental than artifact categories, and therefore they were less affected by children's understanding of the fantasy/reality distinction.

Children's expertise with a given domain can also influence whether fantasy will impact learning new information in that domain. Sharon and Woolley (2004) found domain differences in young children's attributions of human-like characteristics to fantasy characters. They asked 3-, 4-, and 5-year-olds whether certain traits were true of a variety of real and fantasy characters (e.g., "Does a dinosaur need to sleep sometimes?", "Does Santa Claus have parents?"). They found that children showed better discrimination at this task (correctly ascribing these properties to real entities, but not to fantasy entities) for the physical and social domains than for the biological domain. Understanding of the physical and social worlds develops earlier than understanding of biological principles (Carey, 1985; Keil, 1992), and greater knowledge of these domains enabled children to better reason about how properties applied to real vs. non-real entities.

When hearing a story that contains fantasy elements that violate physical or social rules, children with a strong understanding of these domains may be better at understanding that those violations apply only to the story and not to the real world. This would help them avoid incorrectly transferring information about the violation. Additionally, the presence of the clear violations could highlight the realistic information by contrast. This is consistent with the findings of Hopkins and Lillard (2014): Children who read a story containing obvious violations of physical laws showed greater transfer of a physical problem-solving strategy. Viewing the violations may have prompted deeper consideration of whether the novel strategy would be possible in the real world. The high contrast between the impossible fantasy events and the realistic novel information could lead to better transfer.

This hypothesis is supported by the finding that children were more willing to include physical violations in a story than biological violations. Sobel and Weisberg (2012) found that 3- and 4-year-old children generally did not choose an impossible event to complete a story, but that when they did, they were more likely to choose physical violations than biological violations. They argue that children's relatively advanced understanding of the physical world made them more willing to tolerate physical violations. In the less certain biological domain, they preferred to avoid the impossible events. Children may be less likely to transfer information from a story that contains violations in an uncertain domain because they are less confident about what is and what is not real.

Fantasy by domain interactions. There may also be interactions between the type of fantasy and the type of information being taught. The same type of fantasy could have a different effect for learning of different types of information. For example, Ganea and colleagues (2014) found that anthropomorphized animals negatively influenced learning of animal facts, but Smith

(2014) found that familiar anthropomorphized animals led to increased application of a behavioral lesson from a story. Children's learning from stories is a constructive process of considering both the source of the information and the information itself. A story about talking animals is not a good source of information about animal behavior, but animals behaving like people may be able to teach lessons about how humans ought to behave. The fantasy framing used in the current study revolved primarily around non-real characters (wizards, fairies, dragons); this type of fantasy may not have any impact on learning about object functions, but it could impact learning of other types of information.

Additional Predictors of Transfer

Age was a significant predictor of children's transfer of the problem solutions and their judgments of the reality status of the novel objects. Older children were more likely to employ the novel solutions in the analogous problem-solving task; this is unsurprising as many studies have shown that analogical reasoning and problem solving improve with age (Crisafi & Brown, 1986; Daehler & Chen, 1993; Gentner, 1988; Holyoak et al., 1984).

More interesting is that older children rated the novel items as more real than younger children. This could represent a developing ability to separate what is true from what is possible. For example, Woolley and Cox (2007) found that 5-year-olds were more likely than 4-year-olds to say that realistic story events *could* happen, but less likely to say that they *had* happened. Similarly, 6-year-olds were more likely than 4-year-olds to say that improbable events *could* happen, even though they are unlikely (Shtulman & Carey, 2007). Both studies suggest that 4-year-olds believe that events are impossible if they have not actually happened or if they cannot imagine them happening. Thus, in the current study, older children may have been more likely

than younger children to decide that surnits and tulvers *could* be real, even if they had only pretended to use them during the play period.

Two measures of fantasy understanding also predicted children's judgments about the novel objects. Children who were better able to judge the reality status of familiar items and children who believed in fewer event-related entities rated the novel items as real. In other words, children with a better ability to discriminate reality from fantasy were more likely to transfer the novel object information. These children would have been better able to judge that the novel information was realistic (it is perfectly plausible that a tool could exist that helps get things that have fallen out of reach), even if the context it was presented in was not. Importantly, this suggests that transfer from the play period was not the result of a failure to maintain a boundary between pretense and reality. Confusion about the difference between fantasy and reality led to *less* transfer of the novel information. Rather, transfer results from a more sophisticated understanding of fantasy.

At first glance, this finding seems to contradict earlier work showing that children with high fantasy orientation are more likely to quarantine fantasy. Children with high fantasy orientation were less likely to attribute human-like properties to both familiar and novel fantastical entities (Sharon & Woolley, 2004; Woolley et al., 2004) and were less likely to transfer a novel problem-solving strategy from a fantastical story (Richert & Smith, 2011). However, in these studies, fantasy orientation was operationalized as children's preference for or predisposition towards fantasy. Measures included whether children had an imaginary friend, whether they regularly engaged in fantasy play, and whether their favorite games and toys were fantastical in nature. In contrast, the discrimination score used in the current study measures children's *ability* to tell the difference between reality and fantasy.

Preference for fantasy and ability to discriminate fantasy from reality may be related: Sharon and Woolley (2004) found that children above the median on their fantasy orientation measure were more correct on a reality judgment task, and parent-rated fantasy orientation was moderately correlated with fantasy/reality discrimination (r = .25) in the current study. However, they are not the same construct and they could have different effects on children's transfer across the fantasy/reality boundary. Children who choose to engage with fantasy frequently may need to maintain a stronger boundary in order to avoid fantasy seeping into reality as they switch between them. On the other hand, children with a firm understanding of what is real and what is not may be more willing to transfer realistic-seeming information from a fantastical context.

Implications for Education

The value of pretend play in development may lie in the opportunities it presents for children to practice important skills and encounter new situations. Engaging in pretend play requires many of the same skills that underlie language and symbolic understanding (Tamis-LeMonda & Bornstein, 1990; Vygotsky, 1967), executive function (Carlson et al., 2014; Carlson & Moses, 2001), theory of mind (Lillard, 2001; Taylor & Carlson, 1997) and causal reasoning (Gopnik & Walker, 2013), and engaging in pretend play might build up these skills in children. Similarly, pretend play often involves exposure to worlds unlike the child's own, whether they be imaginary situations created by the child or real situations introduced by a more knowledgeable play partner. By this account, allowing children to engage in pretend play is not wasting time, but giving them space to develop important skills and new knowledge.

However, the evidence does not support the argument that pretend play is critical to the development of these skills (see Lillard et al., 2013 for a review). In the most well-controlled

intervention studies, control conditions have been as effective as pretend play training. In the current study, a non-pretend activity was just as effective at conveying novel information as a pretend activity. However, pretend play has rarely been shown to be *worse* than matched non-pretend activities at encouraging the development of skills or teaching new information. What this means for education is that pretend play is neither more nor less effective than other types of instruction. The one advantage may come from the fact that pretend play is an activity children are naturally motivated to engage in, potentially making it easier to implement than other types of learning activities.

There are, however, several important factors to consider before using pretend play to teach young children. The first is that the effectiveness will depend on the type of pretense, and the type of information being presented. This is still a new area of research, and the types of pretense that have been studied thus far is limited. Care must be taken with the use of substitute objects to ensure that children are drawing the correct inferences about the real objects (Hopkins & Lillard, 2014). Consideration should also be given to what type of information is being presented; most investigations into children's learning from pretense and fiction have focused on simple, concrete information such as object labels and functions, physical problem solving, and simple animal facts. One study with elementary school children showed that they learned basic principles about natural selection from a book (Kelemen et al., 2014), but more work in this area is needed before recommending pretense and fiction for teaching more complex and abstract ideas, especially to younger children.

It is also important to manage the demands being placed on children's analogical reasoning when presenting information in fictional settings. Learning from books or play requires children to later apply that information to a new context that could potentially be quite

different from the initial presentation. The factors that influence children's ability to transfer information to analogous situations have been well studied; familiarity, surface similarity, and highlighting the causal structure all increase the odds that children will successfully transfer information to a new situation. Educational materials involving pretense and fantasy will be most effective if they can incorporate these principles to reduce processing demands.

Another point to consider is that characteristics of the individual child will matter when asking them to transfer information from pretense. The current study found that younger children and children who were less sure about the distinction between reality and fantasy were less likely to transfer the novel information. This is consistent with Vygotsky's view of pretense as a zone of proximal development. For learning to occur, the learning context must be just beyond a child's current developmental state. Children do not benefit from learning situations that are either too easy or too difficult for them. In the case of pretense, the body of research thus far suggests that children who are unsure about a domain are likely to completely quarantine novel information; this conservative approach reduces the risk that non-real information will be incorporated into the child's knowledge about the world. It is only with more confidence about the principles governing a particular domain and a better understanding of the fantasy/reality distinction that children are willing to accept novel information from a fictional or fantastical source.

This theory raises the question of whether children are selective about the information they transfer from fiction. Children and adults have been shown to learn incorrect facts from realistic fiction (Marsh et al., 2012); are they selective about what they will learn from fantastical fiction or pretense? These types of fictional worlds contain a mix of things that are real and things that are not real. Harry Potter does magic, but also needs to sleep at night. When children

have a pretend tea party, there is no tea actually present, but they still "pour" from the teapot into the cup before "drinking". For fictional worlds to be effective in educational settings, children must learn only the real information while quarantining everything else. The work on this topic thus far has typically used fantasy themes that were familiar to children; thus, the children already knew that the fantasy information was not real and did not need to decide whether to transfer it. Future work should investigate what children transfer when a fictional world includes novel information that is unlikely to be true of the real world. If, for example, a pretend world included a novel object that defied physical laws, would children correctly judge the object as not real? Can they selectively transfer only realistic information from a pretend scenario that contains both realistic and implausible novel facts or will they quarantine everything to avoid transferring the incorrect information?

Conclusion

In spite of the fact that children generally keep pretense and fiction separate from their understanding of the real world, they are capable of learning at least some types of information from pretend play. The current study showed that neither pretense nor fantasy content influenced children's learning of novel object categories and problem-solving strategies compared to a non-pretend play activity. This does not support the argument that pretend play is a critical component of early education; there was no advantage to embedding the novel information in a pretend context. However, there were also no negative effects of pretense or fantasy, suggesting that at least for some types of information, pretending can be an effective educational tool.

Children with a more sophisticated understanding of the difference between reality and fantasy were most likely to transfer the novel information, suggesting that transfer is an advanced cognitive strategy involving evaluating the novel information itself as well as its

source. This work suggests that children do not passively absorb new information they encounter in a fictional world, but rather that learning from pretense is an active process of integrating the novel information, properties of the fictional world, and the child's own knowledge. Future work should further probe the effects of children's own understanding on their learning from fictional contexts. Additionally, these findings should be extended to other types of fantasy and different domains of knowledge. More work is needed to fully understanding how children process novel information from pretense, but children's natural interest in pretend play and the opportunity it provides to explore novel situations make it potentially valuable as an educational tool.

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Appendix A – Play Period Scripts

Real condition: Blocks activity

- "First, we're going to play with these blocks."

- "Let's try to stack these blocks as high as we can. How high do you think we can stack them?"

- "You know what else we can do with these blocks? We can make shapes. What shape should we make?
  - If no response, "Should we do a triangle or a square?"
  - "What color should we use to make *shape*?"

- "We can also use the blocks to make letters. What letter should we make?"

- "Now, let's line all the blocks up and see if it's long enough to stretch across the whole table. Can you help me put all the blocks in a long line?"

- "Uh oh! I dropped my block into the basket and it's too far to reach without getting out of my chair. Here's what we can do. Let's make a surnit. Surnits have a long handle to help get things that you can't reach!"
  - *Show child how to attach a spoon to a stick and use it to retrieve the dropped block.*
  - *Take it apart again and give the child the chance to try.* "Here, can you make a surnit?"

- "Ok, I think our game is all done. Let's clean these up so we can play our next game."

Real condition: Painting activity

- "Now let's draw a picture. Here's your paintbrush, and here's my paintbrush, and we have some water and some paint."

- "What should we paint a picture of?"
  - If no suggestion, "Let's paint an animal. Should we do a dog or a cat?
- What color should we make [component of picture]?
  - If no response, give child two color alternatives.
    - *Paint child's choice, describe several components of picture as you do so*.

- "What else should we add to our painting?"
  - If no response, give child two options to choose from.

- "I have a stone in this cup that we can use to paint polka dots on our picture, but we can't reach into the cup to get it without spilling the water. Here's what we can do. Let's make a tulver. Tulvers are sticky at the end to help you pick things up!"
  - *Show child how put sticky tack on the end of the stick and use it to retrieve the block.*
  - *Take it apart again and give the child the chance to try.* "Here, can you make a tulver?"

- "Now that we have the stone, we can use it to paint the polka dots in our painting – see?"

- "Ok, I think our paintings are all done. Let's clean up our paints. We're all done with this game."

Realistic pretense condition: Blocks activity

- "First, we're going to play a pretending game. Do you like pretending? We're going to pretend to be builders and build a house."

- "What's the first thing we have to do to build our house?"
  - If child does not make a suggestion, "Let's build the walls first"
  - "Can you help me hammer these walls in place?"
    - *Stack blocks in a square and pretend to hammer them in place.*
  - "What does our house need next?
    - If child does not make a suggestion, "Let's put the roof on"
    - "Can you help me lift these pieces up on top of the house?"

- "Now it's time to paint the house – what color should we paint it?"
  - If no response, "Should we paint it blue or red?"
  - "Let's get our brushes and paint the house."

- "Ok, the house is all done. We should build nice something in the yard now. What do you think we should build?"
  - If no response, "should we plant a garden or make a swimming pool?"
  - "Ok, to plant a garden/make a pool, first we need to dig up the dirt. Can you get your shovel and help me dig?"

- "Phew – that was tough digging. Should we take a break to eat lunch? What do you want to have for lunch?"

- "Uh oh! I dropped my lunchbox into the hole and it's too deep to reach. How can we get it out? I know! Let's pretend to make a surnit. Surnits have a long handle to help get things that you can't reach!"
  - *Show child how to attach a spoon to a stick and use it to retrieve the dropped block.*
  - *Take it apart again and give the child the chance to try.* "Here, can you pretend you're making a surnit?"

- "Ok, I think our house is all done. Let's clean these up so we can play our next game."

Realistic pretense condition: Painting activity

- "Now let's pretend that we're artists. Here's your paintbrush, and here's my paintbrush, and we have some water and some paint here."

- "What should we paint a picture of?"
  - If no suggestion, "Let's paint an animal. Should we do a dog or a cat?"
    - *Act out painting child's choice, describe several components of picture as you do so*.

- "What color should we make [component of picture]?"
  - If no response, give child two color alternatives.
    - *Act out painting component.*

- "What else should we add to our painting?"
  - If no response, give child two options to choose from.

- "We can use a sponge to paint the background. Uh-oh! The sponge is at the bottom of that cup and I can't reach in to get it without spilling the water. I know! Let's pretend to make a tulver. Tulvers are sticky at the end to help you pick things up!"
  - *Show child how to put sticky tack on the end of the stick and use it to retrieve the block.*
  - *Take it apart again and give the child the chance to try.* "Here, can you pretend you're making a tulver?"

- "Now that we have the sponge, we can use it to paint the sky in our painting – see?"

- "Ok, I think our paintings are all done. Let's clean up our paints. We're all done with this pretending game."

Fantasy pretense condition: Blocks activity

- "First, we're going to play a pretending game. Do you like pretending? We're going to pretend to be fairies and build a castle."

- "What's the first thing we have to do to build our castle?"
  - If child does not make a suggestion, "Let's build the walls first"
  - "Can you help me put these stones in place?"
    - *Stack blocks in a square.*
  - "What does our castle need next?"
    - If child does not make a suggestion, "Let's build a tall tower"

- "What color should our castle be?"
  - If no response, "Should we make it silver or gold?"
  - "Let's sprinkle our fairy dust all over the castle to make it [color]."

- "Ok, the castle is all done. What else should we build for our castle?"
  - If no response, "Should we plant a garden or dig a moat?"
  - "Ok. Can you use your magic wand to help me plant a garden/dig a moat?"

- "Look what I have here – it's a crystal ball and we can look into it and see what is happening to other people inside the castle. What do you see in the crystal ball?"
  - *Wait for child's response; follow up with questions about details.*
  - *If they don't come up with anything,* "I think I see the prince/princess in his/her bedroom. What do you think he/she is doing?"

- "Uh oh! I dropped my crystal ball off of the tall tower and it's too far down to reach. How can we get it out? I know! Let's pretend to make a surnit. Surnits have a long handle to help get things that you can't reach!"
  - *Show child how to attach a spoon to a stick and use it to retrieve the dropped block.*
  - *Take it apart again and give the child the chance to try.* "Here, can you pretend you're making a surnit?"

- "Ok, I think our castle is all done. Let's clean these up so we can play our next game."

Fantasy pretense condition: Painting activity

- "Now let's pretend that we're wizards. Here are our magic wands, we can use them to do magic and make things."

- "What should we make first?"
  - "We can make a magical creature. Should we make a dragon or a unicorn?"
  - "What color should it be?"
    - *Act out making child's choice, describe several components as you do so*.

- "What else should we make?"
  - If no response, give child two options to choose from.

- "We can use a magic stone to help us bring the dragon/unicorn to life! Uh-oh! The magic stone is in that cup and I can't reach in to get it without spilling the potion. I know! Let's pretend to make a tulver. Tulvers are sticky on the end to help you pick things up!"
  - *Show child how to put sticky tack on the end of the stick and use it to retrieve the block.*
  - *Take it apart again and give the child the chance to try.* "Here, can you pretend you're making a tulver?"

- "Now that we have the magic stone, we can use it to bring our dragon/unicorn to life – see? Now it can fly away"

- "Ok, I think our pretending game is all done. Let's put these things away."

Appendix B – Direct Memory Questions

Real Condition:

1. What was the first thing we built with the blocks?
2. What shape did we make with the blocks?
3. What color did we use to make the *shape*?
4. What letter(s) did we make with the blocks?
5. What did we do with the blocks after we made letters?
6. What did we paint a picture of?
7. What color was it?
8. What else did we put in our picture?
9. What did we use to paint polka dots in our picture?

Realistic Pretense Condition:

1. What did we build when we were playing with the blocks?
2. What were we pretending to be?
3. What color did we paint the house?
4. What did we build in the yard?
5. What did you have for lunch?
6. What did we paint a picture of?
7. What color was it?
8. What else did we put in our picture?
9. What did we use to paint the background?

Fantasy Pretense Condition

1. What did we build when we were playing with the blocks?
2. What were we pretending to be?
3. What color did we make the castle?
4. What else did we build?
5. What did you see in the crystal ball?
6. What did we make with our magic wands?
7. What color was it?
8. What else did we make?
9. What did we use to bring our dragon/unicorn to life?