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Do children learn from pretense?

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ABSTRACT

Pretend play presents an interesting puzzle. Children generally must keep pretense separate from reality or else pretend would confuse their real-world representations. Children spend a great deal of time pretending, and so failing to take any information from pretend scenarios would present a lost opportunity; however, little research has investigated whether it is possible or efficient for children to learn new information they encounter during pretend play. In two tightly controlled studies using blind testers, we taught children information of two types (labels and object functions) in a pretend or real context. Children learned the novel functions in the pretend condition, and they inferred that the novel object would be similar in appearance to the substitute used to represent it during pretense. These findings coincide with other recent work suggesting that children can learn new information in pretense contexts that they can then apply to the real world, although this learning may differ in important ways from learning in real contexts.

Introduction

Pretend play is a prominent feature of early childhood, and it is often incorporated into educational settings. In virtually every preschool in the United States, one encounters evidence of the emphasis placed on pretending. Parents and teachers provide young children with costumes, props, and other toys to encourage them to engage in pretend play. Many such toys, such as play kitchens and doctor's sets, claim to help children learn about the real thing. Yet despite reams of research on the effect of pretend play on development (see Lillard et al., 2013, for a review), very little research has focused on whether children can apply what they learn when pretending to the real world.

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Theories about the permeability of the boundary between reality and pretense exist on a continuum from complete permeability at one extreme to strict quarantine at the other, with selective transfer somewhere in the middle. Few theorists would advocate for the extreme versions of either of these views, but they are useful to consider as anchors for this continuum. Complete permeability could be a consequence of children failing to distinguish reality and pretense, really a form of Piagetian realism (Piaget, 1929). If complete permeability exists across pretend and real contexts, what is learned while pretending is transparently known in real contexts because the two contexts are not differentiated. However, this would not be an efficient system because many things encountered in pretense are not real and should not be learned; therefore, young pretenders would show evidence of far more confusion than they do (Lillard & Witherington, 2004). Leslie (1987) made this point clear; a child watching someone pretend that a banana is a telephone represents the banana as a telephone only momentarily, avoiding "representational abuse" that would cause the child to represent bananas as telephones beyond the pretense episode. As Harris (2000) put it, the pretense episode is "flagged" as a special temporary case of banana–telephone equivalence. Young children do not routinely confuse pretend and real worlds (Lillard, 1994; Woolley, 1997). The fact that the pretend world *must* be quarantined from the real world renders the idea that everything learned in pretending transfers to real impossible. When a mother says of the banana, "This is a telephone," children do not then assume (outside of the pretend context) that the banana is a telephone.

At the opposite end of the spectrum from complete permeability is strict quarantine; pretend and real worlds are strictly separate, with no transmigration across them. We have just seen that at least some quarantine is logically necessary because children who pretend a banana is a telephone do not subsequently think bananas really are a kind of telephone. However, the pretend–real boundary cannot be completely impermeable either because children clearly use real-world knowledge when they pretend. Once pretenders decide a banana is a pretend telephone, they can use their real-world knowledge of telephones to guide their behavior (e.g., make the telephone ring, pick it up to their ear and talk into it). There is at least unidirectional transfer, then, with real-world information moving into the pretend realm (Nichols & Stich, 2000).

Having established that (a) children must distinguish between pretend and real, (b) there is not complete permeability across these contexts, and yet (c) real information must wend its way from the real world into the pretend world, we ask whether there is selective transfer in the opposite direction such that at least some information crosses from the pretend realm into the real realm? Many studies have investigated whether children will learn novel information from fictional stories (Ganea, Canfield, Simons-Ghafari, & Chou, 2014; Ganea, Pickard, & DeLoache, 2008; Richert, Shawber, Hoffman, & Taylor, 2009; Richert & Smith, 2011; Walker, Gopnik, & Ganea, 2014), but relatively few have investigated the analogous question in pretend play. Two recent studies might support the idea that some information can cross from pretend worlds to real ones, enabling learning from pretense (Sutherland & Friedman, 2012, 2013). In both studies, preschoolers were shown a puppet introduced as a "nerp" and then told about the nerp's preferences and fears. For example, the nerp pretended to eat and enjoy a cherry (represented by a red bead) but pretended to dislike a carrot (an orange bead). Then (to demarcate the pretend and real situations) the experimenter put the puppet away and brought out a book with a photograph of a loris (an animal most children have not seen or heard of). Children were told that the loris was a nerp. For the test, children were asked four questions about what the nerp did and did not like; in some studies the questions were forced-choice, pairing objects seen previously with new objects, and in others they were open-ended. Children performed quite well on the forced-choice questions (e.g., "Do nerps not like to eat carrots or corn?"), but across several studies performance on open-ended questions (e.g., "Can you tell me what nerps do not like to eat?") was approximately 50%. Because responses to the forced-choice questions might be due to recognizing what had previously been associated with nerps, the open-ended results suggest that learning from pretense, although possible, may be difficult for young children. In addition, in these studies there was no comparison case of extending from real to real; thus, we do not know how learning in pretense contexts compares with learning similar information in real contexts.

The current studies extend these prior findings in several ways. First, we made the break between the pretend and real situations more extreme to be even more certain that children would know pretending had ended before the real test began. This was accomplished by (a) using a different experimenter and environment and (b) including another task between demonstration and test. Using a different experimenter also allowed for blind post-testing, which others have noted is particularly important in studies of pretend because results obtained with knowledgeable experimenters have not always replicated with those obtained with blind ones (see Lillard et al., 2013, for a review; Smith, 1988).

Second, in addition to testing children's learning of novel objects' labels, the current studies also examined learning novel objects' functions and, furthermore, what inferences children draw about novel objects' appearances. If children encounter a novel item during pretense (e.g., their play partner pretends to use a "whisk" to stir pancake batter), what will they learn about whisks, a type of object they have never seen before? If function information learned in pretense is quarantined from reality, children should not form any beliefs about whisks in the real world. However, if function information can cross the pretend–real boundary, children might learn that whisks are used when making pancakes.

In addition to learning the function of a novel object, children might also make inferences about its appearance. What will they think a whisk looks like? This could depend on what type of substitute object their play partner chooses to use as a whisk. Children are better at producing their own pretend play actions and at interpreting those actions performed by others when the substitute object is similar in appearance and function to what it represents (Bigham & Bourchier-Sutton, 2007; Hopkins, Smith, & Lillard, 2014; Jackowitz & Watson, 1980). Therefore, children might assume that substitute objects are chosen because they are similar to their pretend identities. In the above example, if a comb is used as a pretend whisk, children might infer that whisks are similar in appearance to combs.

The current studies examined whether children can learn object appearance and function information in pretense. We also included a realistic condition to examine whether the context in which new information was learned affected the inferences children made about a novel object category.

Study 1

In Study 1, we presented children with a familiar object (e.g., a screwdriver) that was given a novel label ("sprock") and a novel function (pushing a ball out of a tube) in either a pretend or real context. Children were then (a) shown a set of objects and asked to identify which object in the set might be a real sprock and (b) asked to demonstrate what sprocks do. The objects varied in terms of how similar they were to the screwdriver in appearance and function. If children do not transfer any information from pretense to reality, children in the pretend condition would choose at chance when asked to select a real sprock and would not demonstrate a function learned in pretense once the pretend episode was over. In contrast, if children do recall a novel function they were taught during pretend play, this would suggest that they can transfer function information from pretend to reality. In the study, 5-year-olds were tested because they are in the "high season" of pretend play (Singer & Singer, 1990) and thus, might be most likely to learn in pretend contexts.

Method

Participants

Participants were 56 typically developing 4½- to 5½-year-old children (27 girls, mean age = 4;11 [years;months], range = 4;7–5;7). Participants were recruited from the local community and, reflecting the demographics of local families able to come to the laboratory for studies, were primarily White and from middle-class backgrounds.

Materials and procedure

The procedure had two phases: (a) a demonstration phase introducing children to a novel object label and function in a pretend or real context and (b) a test phase assessing the inferences children made about the appearance of the novel object and whether they had learned the novel function. Fig. 1 is a flow chart of the procedure. Participants were assigned to either the pretend or real condition.

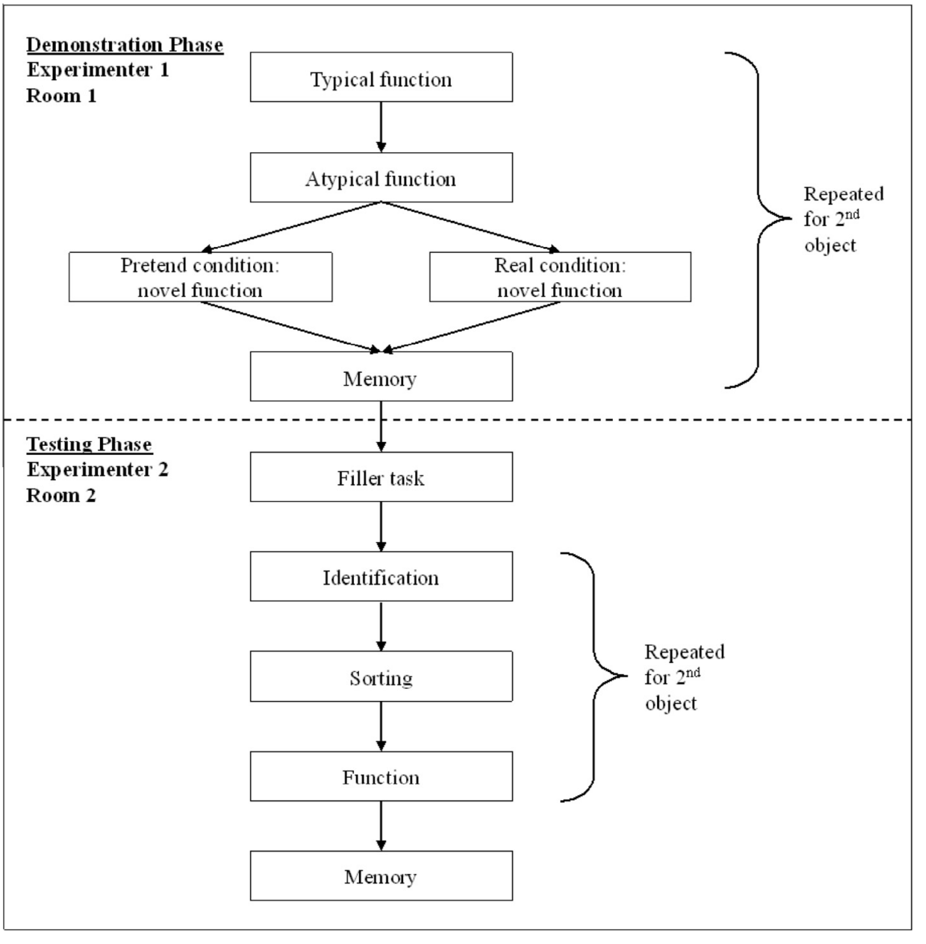

Fig. 1. Schematic of Study 1 procedure.

Demonstration phase. A block of three demonstration trials was presented for each of two familiar objects (a screwdriver and a spoon). The three trials in each block demonstrated (in order) a typical function, an atypical function, and a novel function for the object. The order of blocks was counterbalanced between participants, and so half of the participants in each condition saw the block of screwdriver trials first and half saw the block of spoon trials first. Fig. 2 shows the objects used during the demonstration phase.

In both conditions, the experimenter began by introducing the object (screwdriver or spoon) and asking the child to identify it. Next, for the typical function trial, she brought out the appropriate complement object (a screw in a block of wood or a cup full of rice) and told the child, "See, this is what screwdrivers/spoons do," while demonstrating the function (screwing in the screw or scooping the rice). The child was then asked to perform the action. Next, for the atypical function trial, the experimenter said, "Screwdrivers/spoons can also do this," while banging on a drum with the screwdriver or digging in a sandbox with the spoon. Again, the child then repeated the action after the experimenter.

The final trial in each block was the novel function trial; this was the only point during the demonstration where the pretend and real conditions differed. In the pretend condition the experimenter told the child, "Let's pretend that this screwdriver/spoon is a sprock/coodle," whereas in the real condition the experimenter said, "Did you know that this screwdriver/spoon is *also* a sprock/coodle?" In

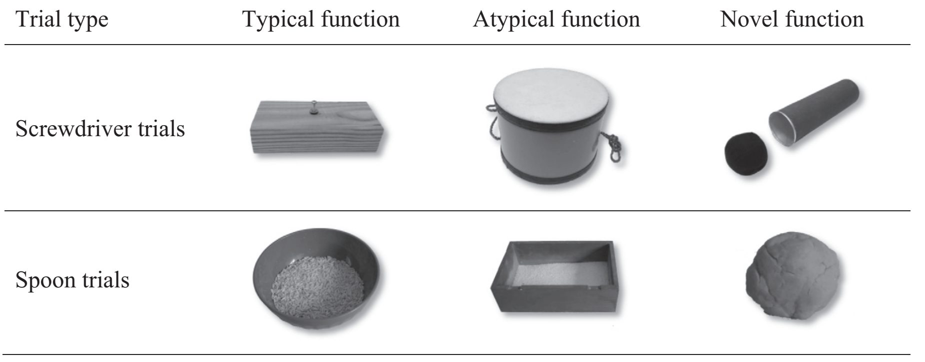

Fig. 2. Objects used during the demonstration phase in Study 1. From left to right, beginning with the top row, the objects are a screw in a wooden block, a toy drum, a plush ball inside a tube, a bowl of rice, sand in a wooden box, and a ball of clay.

both conditions, the experimenter then demonstrated the novel function (pushing a ball out of a tube with the screwdriver or flattening a ball of Play-Doh with the spoon), saying, "This is what sprocks/coodles do." Again, the child was asked to perform the action.

In both conditions, after the novel function trial, a memory question was asked to reinforce the pretend or real context and the novel label. For the pretend condition, the experimenter said, "This is really a screwdriver/spoon, but we were pretending it was something else. What else were we pretending it was?" In the real condition, the experimenter said, "This is really a screwdriver/spoon, but we said it's really something else too. What else is it really?" Children answered these questions correctly a little more than half of the time (54% of trials). If children did not respond or said they did not know (40% of trials) or responded incorrectly (6% of trials), the experimenter reminded them of the correct label.[1]

Test phase. After the demonstration phase, the child was brought into a different room and introduced to a second experimenter who was not aware of whether the child was in the pretend or real condition. This second experimenter administered an inhibitory control measure (the grass/snow task; Carlson & Moses, 2001) as a filler task and then the test phase of the experiment. Using a different experimenter and environment, as well as including another task between demonstration and test, was done to ensure that children did not think the test phase was a continuation of the pretending game from the demonstration phase. The test phase consisted of three types of trials: identification, sorting, and function (detailed below). The three trials were administered in that order for the first object (sprock or coodle) presented during the demonstration phase and then were repeated for the second object. Following the two blocks of those three trials, another set of memory questions was given.

On identification trials, the experimenter placed the appropriate set of test objects on the table in a random order. She asked the child to identify which object was a sprock or coodle ("I think there's a sprock here; can you find the sprock?"). The objects in these test sets varied in terms of their similarity to the demonstration object (screwdriver or spoon) in both form and function in order to explore the inferences children made about the properties of real sprocks and coodles. Three objects in each set were similar in form to the demonstration object, and three were dissimilar. Within each form category, one object had a similar function to the demonstration object, one had a dissimilar function, and one was a novel object with an unknown function (see Fig. 3).

[1] Although the success rate on this question may seem low, asking children to recall the labels as we did here is a more stringent test than recognition memory, which is all that was required during the test phase. Furthermore, the primary purpose of this question was not to test children's memory but rather to reinforce the pretend or real context. There was no difference between the conditions, and removing these children from analyses did not change the pattern of results.

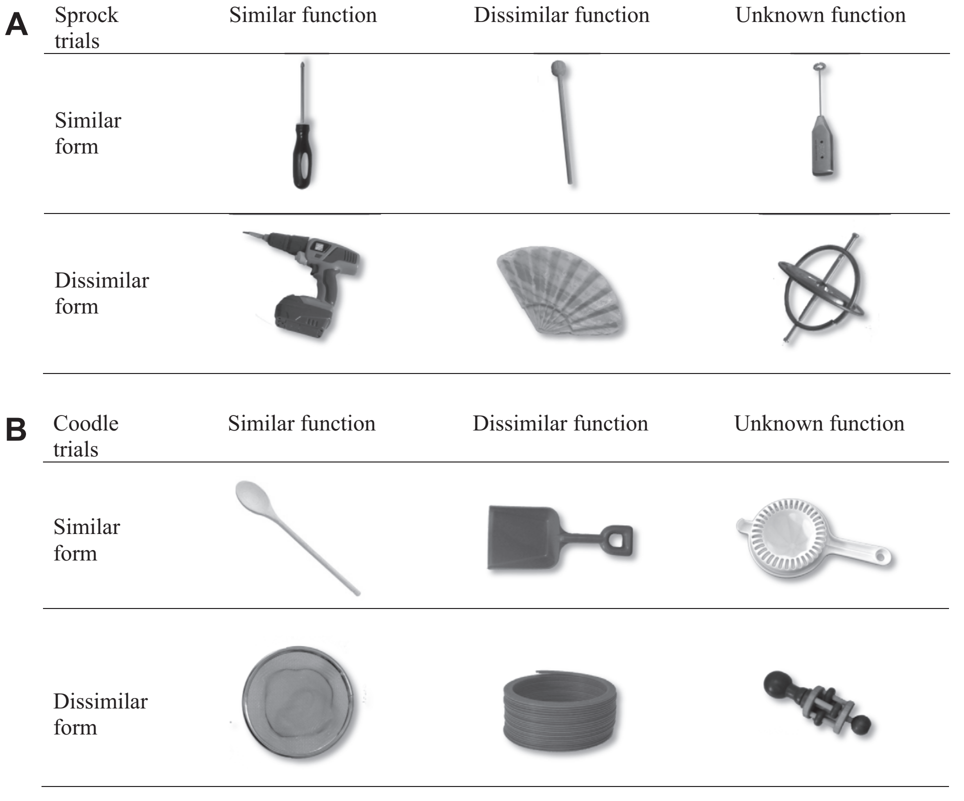

Fig. 3. (A) Test objects used on identification and sorting trials for the sprock. From left to right, beginning with the top row, the objects are a screwdriver, a drumstick, a beverage frother, a toy power drill, soap, and a gyroscope. (B) Test objects used on identification and sorting trials for the coodle. From left to right, beginning with the top row, the objects are a spoon, a sand shovel, a juicer, a metal mesh strainer, a Slinky, and a wooden rattle.

Because it is possible that children would think the novel label applied to more than one of the test objects, an open-ended sorting trial was included. The experimenter placed two boxes on the table and told the child that sprocks or coodles go in one box and other toys go in the other box. She placed the object chosen by the child in the identification trial in the target box and then asked the child to "put everything away" (meaning the other five objects in the set).

Finally, the function trials measured whether children associated the novel object label ("sprock") with the novel function they had been taught during the demonstration phase (pushing a ball from a tube). The child was introduced to a new novel object and told that it was another sprock or coodle (Fig. 4). The experimenter then brought out the three complement objects from the demonstration phase, handed the child the new sprock or coodle, and asked the child which of the three possible functions is "what sprocks/coodles are for." For example, on sprock trials the child could choose between the typical function (screwing in a screw), the atypical function (banging a drum), or the novel function (pushing a ball out of a tube) (see Fig. 2). Note that children had equal amounts of exposure to all three complement objects during the demonstration phase, and no complement object had been previously associated with the novel object used in the function trial. In addition, children could not make their decision only by choosing a function not typically associated with the familiar object because this was true of both the atypical and novel functions. Because children could choose only one option, this trial measured what children considered to be the primary function, teleologically speaking, of the novel object; it does not rule out the possibility that they also remembered the other

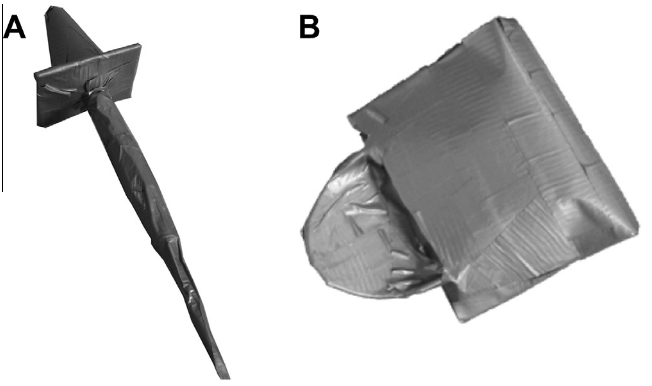

Fig. 4. The novel sprock (A) and coodle (B) used in Study 1.

functions from the demonstration phase. After these three trials (identification, sorting, and function) were completed for the first object, they were repeated for the second object prior to the final memory trials.

For the final memory trials, the experimenter brought out the screwdriver or spoon (whichever was demonstrated first for that child) used during the demonstration phase. She first asked the child to label the object and then asked whether the child and the first experimenter had called the object by any other name (label recall). The child was prompted with a forced-choice question if he or she could not recall any label ("Did you call this a sprock or a coodle?"). If the child answered incorrectly, feedback was given. The experimenter then asked the child whether the object was really a sprock or coodle or whether the child pretended it was a sprock or coodle (context recall). These questions were then repeated with the second demonstration object. The order of the context recall question (real/pretend or pretend/real) was counterbalanced between participants.

Children answered the label recall questions correctly on 81% of trials in the real condition and on 79% of trials in the pretend condition. On the context recall questions, children were correct on 60% of trials in the real condition and on 98% of trials in the pretend condition.[2] Examining the overall pattern of responding for children who answered any of these questions incorrectly showed that they performed similarly to other children in their respective conditions. Excluding them did not change the pattern of results, and so the analyses reported here were conducted on the whole sample ($N = 56$: 21 children in the pretend condition and 35 in the real condition).

Coding. All participants were recorded during the study procedure, and a trained research assistant coded the recordings from video after the session. A second research assistant, who was unaware of the experimental hypotheses and blind to participant condition, coded 20% of the videos; intercoder agreement was 100%. For identification test trials, coders noted which of the six objects the child first selected as being a sprock or coodle. For sorting trials, they noted which other objects were placed in the sprock or coodle box. For function test trials, coders noted which function the child demonstrated for the sprock or coodle: typical (e.g., screwing in a screw), atypical (e.g., banging on a drum), or novel (e.g., pushing a ball out of a tube).

[2] We suspect that the reason for the relatively poor performance of children in the real condition on the context recall question was due to a mutual exclusivity bias (Markman & Wachtel, 1988). Children in the real condition likely resisted explicitly applying two labels to a familiar object. Anecdotally, several children initially responded to the context recall question ("Is this really a sprock or did you pretend it was a sprock?") with "It's really a screwdriver"; when prompted, they responded that they pretended it was a sprock. Given that children who answered this question incorrectly responded to the rest of the procedure in a manner consistent with other children in the real condition, we believe that confusion occurred only in response to the context recall question.

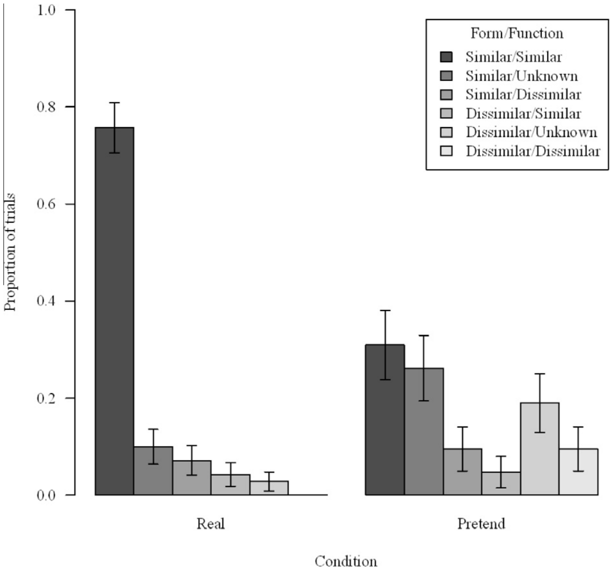

Fig. 5. Children's object choice on the identification trial in Study 1. Error bars represent ±1 standard error. No children in the real condition selected the dissimilar/dissimilar object category.

Results

Identification

Children's choices on the identification trials are shown in Fig. 5. The two most selected categories, together representing participants' choices on 75% of trials, were the similar form/similar function object (e.g., the screwdriver) and the similar form/unknown function object (e.g., the frother). The number of children who selected each of these items on 0, 1, or 2 trials is shown in Table 1.

When children were taught a novel object label and function in a realistic context, most seemed to learn that the novel label was simply another name for the familiar object (i.e., that screwdrivers can also be called sprocks or perhaps that "sprock" is a superordinate category that includes screwdrivers); when asked to find a sprock, children in the real condition chose the similar form/similar function object (e.g., the screwdriver) on a majority (75.7%) of trials and more often than children in the pretend condition (31.0% of trials). The distribution of children who selected this object category on 0, 1, or 2 trials differed significantly between conditions, $\chi^2(2, N = 56) = 15.04$, $p < .001$, $\phi = .52$.

Conversely, children in the pretend condition chose the similar form/unknown function object more often (26.2% of trials) than children in the real condition (10.0% of trials). The distribution of children who selected this object category on 0, 1, or 2 trials was marginally different between conditions (Fisher's exact test,[3] $p = .07$). This suggests that children in the pretend condition were less likely to interpret the novel label as another name for the familiar object; rather, they may have inferred that if a screwdriver is a good pretend substitute for a sprock, sprocks are likely to be long and skinny like screwdrivers.

Sorting

The sorting procedure added little information because children generally did not apply the novel label to more than one object; when asked to sort the remaining five test objects, children sorted an average of an additional 0.79 items into the target box after the identification trial. On the majority of trials, children did not sort any additional objects into the target box (71.4% of trials in the real

[3] Fisher's exact test was used here because it is more accurate than a chi-square test when there are cells with expected values of less than 5.

Table 1
Study 1: Proportion of children per condition who selected each object category on 0, 1, or 2 identification trials.

	Similar form/similar function		Similar form/unknown function	
	Real	Pretend	Real	Pretend
Selected on 0 trials	.11	.57	.80	.62
Selected on 1 trial	.26	.24	.20	.24
Selected on 2 trials	.63	.19	.00	.14

condition and 64.3% of trials in the pretend condition). The average number of objects sorted into the target box did not differ significantly between the real and pretend conditions, $t(110) = 1.05$, $p = .29$.

Function

Results from the function trial are shown in Fig. 6. The number of children who selected each function type on 0, 1, or 2 trials is shown in Table 2. When asked to show what sprocks are for, children in the real condition chose the typical function (e.g., screwing in a screw) on 48.6% of trials; children in the pretend condition selected the typical function on only 21.4% of trials. The distribution of children who selected the typical function on 0, 1, or 2 trials differed significantly between conditions (Fisher's exact test, $p = .01$).

Children in the pretend condition showed evidence of learning the function information presented during the demonstration phase. They chose the novel function (e.g., pushing the ball from the tube) on the majority (59.5%) of trials; children in the real condition selected the novel function on only 24.2% of trials. The distribution of children who selected the novel function on 0, 1, or 2 trials differed significantly between conditions (Fisher's exact test, $p < .01$). There was not a significant difference between conditions for the atypical functions (Fisher's exact test, $p = .28$). Children selected the atypical function on 19.0% of trials in the pretend condition and on 27.1% of trials in the real condition.

Discussion

The results of Study 1 suggest that children can learn novel object labels and functions from pretense; the use of a pretend context did not cause children to disregard the novel information as not

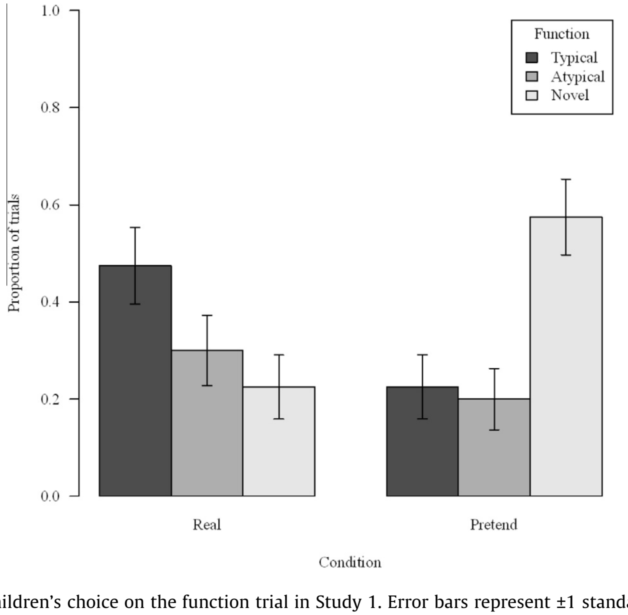

Fig. 6. Children's choice on the function trial in Study 1. Error bars represent ±1 standard error.

Table 2
Proportion of children per condition who demonstrated each function type on 0, 1, or 2 function trials.

	Atypical function		Typical function		Novel function	
	Real	Pretend	Real	Pretend	Real	Pretend
Selected on 0 trials	.49	.67	.23	.62	.57	.24
Selected on 1 trial	.49	.28	.57	.33	.37	.33
Selected on 2 trials	.02	.05	.20	.05	.06	.43

real. However, they made qualitatively different inferences about novel objects presented in a pretend context than in a real context. In the pretend condition, the majority of children learned the novel function they had been taught, and they were more likely than children in the real condition to infer that the novel object would be similar in appearance to the substitute used to represent it.

Children who learned the information in a realistic context showed a different pattern of responses, suggesting that they applied the novel label "sprock" to their existing concept of screwdrivers. The majority selected another screwdriver when asked to identify a sprock and demonstrated the typical screwdriver function when asked what sprocks are for. Although children of this age tend to resist applying a new label to an object for which they already have a name (Markman & Wachtel, 1988), pragmatic cues can lead them to accept label information that is counter to their own intuitions. Jaswal (2004) found that preschoolers would accept unexpected labels for an object when the speaker gave explicit or implicit cues that the label was intentional and not an error (e.g., "You're not going to believe this, but this is actually a cat"). During the training phase here, the experimenter's use of the phrase "Did you know . . ." may have encouraged children to accept a novel label even though they already knew the name of the object.

It is possible that children's selection of the similar form/unknown function object in the pretend condition was also due to a mutual exclusivity bias; when asked to apply a novel label to an object in a set, they chose one for which they did not already have a name. However, this could not be the only driving force behind their choices given that they did not choose at chance between the two unknown objects in the test set. Rather, their choices seemed to be guided by an inference that the novel object would be similar in shape to the substitute used during the training phase; children in the pretend condition selected one of the similar form objects on the majority of trials.

One potential concern is that children in the pretend condition did choose the similar form/similar function object on roughly one third of the trials, as most children in the real condition did. This could mean that children who chose this object had ignored the pretend manipulation during training. However, children in the pretend condition chose this object less systematically; the majority (63%) of children in the real condition selected this object type on both trials as compared with only 19% of children in the pretend condition who did so. Children's occasional selection of this object in the pretend condition seems to be part of their larger bias to select objects that were similar in form to the original training object.

Study 2

Another possible explanation for the findings of Study 1 is that the functions children were taught biased their responding. The function of pushing a ball out of a tube can be completed only with an object that affords pushing balls out of tubes, that is, a long and skinny object. For example, children who learned that sprocks are for pushing balls out of tubes may have used that information to decide which item was a sprock, in which case their responding was not guided by a general tendency to assume that a novel object must be similar in appearance to the substitute used to represent it. In Study 2, we investigated the inferences children would make about the novel object without using a function that would constrain its possible appearance.

To keep the procedure as similar as possible to Study 1, in Study 2 children were provided with the same *amount* of information about the novel object as in Study 1, but the *type* of information differed such that it did not place any constraints on the possible shape of the novel object. We chose a non-obvious property that would have no bearing on its possible form—ownership. Importantly, in this adapted procedure, we were not interested in whether children would learn ownership information; rather, we were interested in whether the results of Study 1 would hold when function information was not provided. If the results of Study 1 reflect a general bias to assume that substitute objects are similar in appearance to the objects they represent, we would expect the same results in Study 2. If, on the other hand, the function information led children to choose objects capable of performing those functions, we should see a different pattern of responding when no information about function is provided.

Method

Participants

Participants were 54 typically developing 4½- to 5½-year-old children (28 girls, $M = 5;0$, range = 4;0–5;6). Participants were recruited from the local community and were primarily White and from middle-class backgrounds. An additional 2 children were excluded due to experiencing equipment failure ($n = 1$) and choosing not to complete the procedure ($n = 1$).

Procedure

As in Study 1, there was both a demonstration phase and a test phase. Participants were randomly assigned to either the pretend or real condition.

Demonstration phase. The demonstration phase was like that of Study 1 except that children were taught about ownership rather than function. Again, there were two blocks of three trials each; the order of blocks was counterbalanced between participants. Each child was first shown two familiar objects and told to whom each belonged. For example, in the screwdriver block, the child was shown a pinwheel and told, “This pinwheel belongs to my friend Fred.” The child was given a chance to hold or play with the pinwheel briefly before the experimenter put it away. On the second trial, the experimenter showed the child a cup and said it belonged to her friend Jenny. As in Study 1, the third trial presented a novel label for a familiar object. The experimenter showed the child the screwdriver and said either “Let’s pretend this screwdriver is a sprock” (pretend condition) or “Did you know that this screwdriver is also a sprock?” (real condition). In both conditions, she then said, “The sprock belongs to my friend Steven.” The same memory check question from Study 1 was asked after the novel function trial to reinforce the pretend or real context and the novel label. Children answered these questions correctly the majority of the time (60% of trials). If children did not respond or said they did not know (34% of trials) or responded incorrectly (6% of trials), the experimenter reminded them of the correct label.[4] This sequence was then repeated for the second block of trials with three new objects (toy car, ball, and spoon) belonging to three new friends.

Test phase. Everything about the test phase was identical to Study 1 except that the function trial was eliminated because no function was taught during the demonstration phase. Because the focus of this study was the inferences that children drew about the novel object during the identification trials, their learning of the ownership information taught during demonstration was not assessed. Thus, in a new room with a new blind experimenter, all participants received the filler task followed by identification and sorting trials for both the screwdriver and spoon object sets (see Fig. 3). The same objects from Study 1 were used to allow for a direct comparison of the results. The same memory questions from Study 1 were administered at the end of the procedure. Recall that for these the experimenter first asked the child to label the object and then asked whether the child and the first experimenter had called the object by any other name (label recall); after that, she asked whether the object was really a sprock or coodle or whether the child pretended it was a sprock or coodle (context recall). These questions were then repeated with the second demonstration object. Similarly to Study 1, children answered the label recall questions correctly on 84% of trials in the real condition

[4] As in Study 1, removing children who did not answer these questions correctly did not alter the pattern of results.

and on 85% of trials in the pretend condition. On the context recall questions, children answered correctly on 63% of trials in the real condition and on 100% of trials in the pretend condition. Examining the pattern of responding for children who answered any of these questions incorrectly showed that they performed similarly to other children in their respective conditions, and results are reported for the whole sample ($N = 54$: 20 children in the pretend condition and 34 in the real condition).

A second coder blind to condition and experimental hypotheses coded 20% of participants; inter-rater agreement was 100% for the identification trials and 97.9% for the sorting trials. Disagreements were resolved by the first author.

Results and discussion

As in Study 1, each object category could be selected by a participant on 0, 1, or 2 identification trials. Chi-square tests were used to determine whether the distribution of children's response patterns differed significantly between the real and pretend conditions.

Identification

The results of Study 2 (Fig. 7) replicated the findings from Study 1. The proportion of children who selected the similar form/similar function or similar form/unknown function items on 0, 1, or 2 trials is shown in Table 3. When asked to find the sprock among the set of six objects, children in the real condition chose the similar form/similar function object (e.g., the screwdriver) on a majority (72.1%) of trials and more often than children in the pretend condition (47.5% of trials). The distribution of children who selected this object category on 0, 1, or 2 trials was marginally different between conditions (Fisher's exact test, $p = .08$).

In the pretend condition, even though the taught information (ownership) had no relation to the object's appearance, children chose the similar form/unknown function object (e.g., the frother) more often (40.0% of trials) than children in the real condition (13.2%). The distribution of children who selected this object category on 0, 1, or 2 trials differed significantly between conditions (Fisher's exact test, $p < .01$).

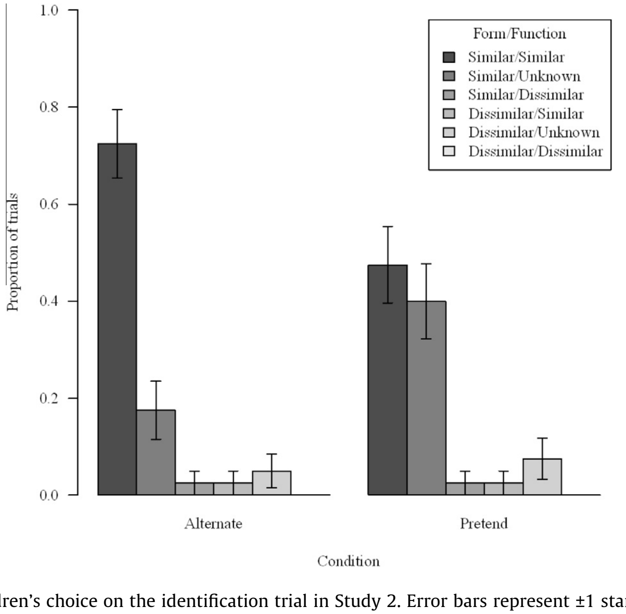

Fig. 7. Children's choice on the identification trial in Study 2. Error bars represent ±1 standard error.

Table 3
Study 2: Number of children who selected each object category on 0, 1, or 2 identification trials.

Condition	Similar form/similar function		Similar form/unknown function	
	Real	Pretend	Real	Pretend
Selected on 0 trials	.12	.35	.74	.45
Selected on 1 trial	.32	.35	.26	.30
Selected on 2 trials	.56	.30	.00	.25

Sorting

As in Study 1, children generally did not apply the novel label to more than one object; on average, children sorted an additional 0.45 objects (of the 5 objects remaining) into the target box. On 76.5% of trials in the real condition and 65% of trials in the pretend condition, children did not sort any additional objects into the target box. The number of objects sorted into the target box did not differ significantly between the two conditions, $t(106) = -0.43$, $p = .67$.

Combined analyses

To confirm that children's pattern of responding did not differ significantly between Study 1 and Study 2, a multinomial logistic regression predicting which object children chose on identification trials was used to analyze the data of the two studies combined ($N = 110$); this type of analysis is appropriate for data where the dependent variable is categorical but non-binary. Fig. 8 shows the results from the identification trials combined across both studies.

To avoid having empty cells in the dependent variable (some objects were never chosen in certain conditions), for this analysis all objects were collapsed into three categories, separating out the two object types chosen most frequently from the others. The *similar* object category included similar form/similar function objects (the screwdriver and spoon), the *unknown* category included similar form/unknown function objects (the frother and juicer), and the *other* category included all other objects. The initial model included the predictors age, gender, trial type (sprock or coodle), study, and condition as well as the Condition × Study and Condition × Trial Type interactions.

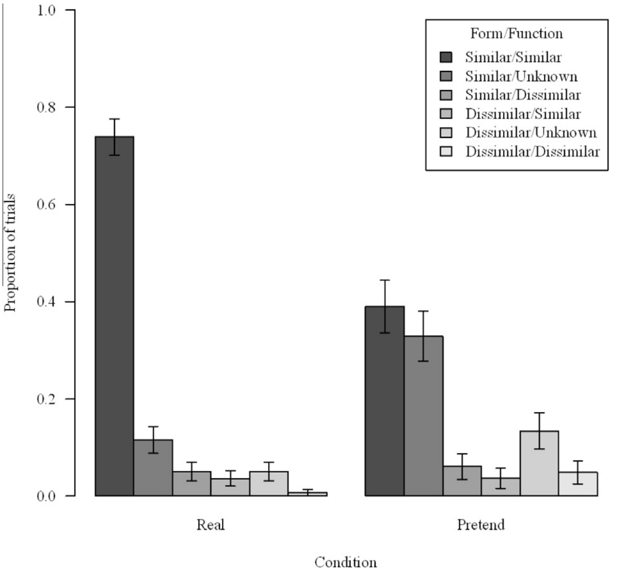

Fig. 8. Children's choice on the identification trial collapsed across Study 1 and Study 2. Error bars represent ±1 standard error.

Table 4
Multinomial logistic regression analysis of combined data from Study 1 and Study 2.

Predictor		β	Standard error	t	p
Intercept	Other objects	1.32	0.52	2.52	<.05
	Similar objects	2.89	0.47	6.21	<.001
Trial type	Other objects	−0.96	0.47	−2.06	<.05
	Similar objects	−1.41	0.41	−3.45	<.001
Study	Other objects	−0.97	0.45	−2.14	<.05
	Similar objects	−0.32	0.39	−0.82	.41
Condition	Other objects	−0.47	0.45	−1.03	.30
	Similar objects	−1.81	0.39	−4.58	<.001

Log likelihood = −184.15 (χ^2 = 45.34, p < .001).
McFadden R^2 = .11.
Note. The intercept includes unknown objects, coodle trials, Study 1, and the real condition. In this type of regression, the estimate for each predictor indicates how that predictor changes the likelihood of a response falling into a particular category relative to the category in the intercept (in this case, unknown objects). For example, the negative estimate for "Trial type, similar objects" means that children were less likely to choose the similar objects on sprock trials than on coodle trials (the level in the intercept). Because the dependent variable here has three categories (similar, unknown, and other objects), each predictor has two separate estimates: one for similar objects and one for other objects.

Neither interaction was significant, and the interactions were removed from the model. The model that best fit the data (as indicated by log likelihood) can be seen in Table 4. Age and gender were not significant and were also removed; their removal did not change the significance level of any other predictors. There were significant main effects of trial type, study, and condition. Children were less likely to choose the similar objects or other objects on sprock trials than on coodle trials. The unknown object used on coodle trials was a citrus juicer; although intended to be a novel object, from children's spontaneous comments it seemed that many children were familiar with it, which would account for their choosing it less than the unknown object used on sprock trials. Children were less likely to choose the other objects in Study 2 than in Study 1; the procedure in Study 2 was shorter and simpler, and so children's attention may have been more focused than in Study 1.

Importantly, the main effect of condition was significant even when controlling for these other predictors; children were less likely to choose the similar objects (the screwdriver and spoon) in the pretend condition than in the real condition (odds ratio = 4.52). In addition, the interaction between condition and study was not significant. This analysis confirms that children's bias to choose similar form objects in the pretend condition of Study 1 was not due solely to the fact that we taught them a function that could best be performed by long skinny objects. The same bias was evident in Study 2, when the information taught about the objects (ownership) carried no information about the novel object's form. Therefore, the difference observed between the real and pretend conditions was unaffected by the type of information taught during the demonstration phase.

General discussion

The experiments presented here suggest that children can learn information about novel objects and their functions during a pretend episode. This extends past research by directly comparing a pretend condition and a real condition and by investigating children's learning of different types of information—object function and identity—with substitute objects that differ in appearance and function. Because substitute object play is one of the earliest and most prevalent forms of pretense, examining the effect of substitute objects on how children extend knowledge from pretense is important. Children in this study made inferences about novel objects' appearances based on the characteristics of the substitute objects used to represent them during a pretend scenario. Importantly, these inferences were qualitatively different from those drawn about novel information presented in a realistic context. Children in the pretend condition were more likely to extend the label to novel objects similar in appearance to the substitute used during pretense, but children in the real condition tended to apply the label only to the object used during the learning episode.

Children also differed in terms of the inferences they made about the primary functions of the novel objects; when asked to identify "what sprocks are for," the majority of children in the pretend condition chose the novel function, but the majority of children in the real condition chose the typical function. As noted earlier, this question does not allow us to rule out the possibility that children in both conditions remembered all three functions equally. However, even if they were able to recall having seen all three functions, the question of interest is which function they *associated* with the novel object. Given other data showing that children rapidly map functions to novel artifacts and subsequently resist using them for other functions (Casler & Kelemen, 2005, 2007), children's first choice is likely the best indicator of the function they associate most strongly with the novel object category.

Furthermore, the results of the function trials dovetail neatly with the results of the identification trials. Children in the real condition seemed to have associated the novel word "sprock" with their existing concept of screwdrivers; they chose a screwdriver when asked to identify another sprock and associated sprocks with the typical function of screwdrivers, namely screwing in a screw. This is contrary to children in the pretend condition, who showed evidence of forming a new concept of sprocks as objects that share perceptual properties with screwdrivers and are primarily associated with the function of pushing balls out of tubes.

A potential concern is that, despite our efforts to make a clear demarcation between the demonstration and test phases, children in the pretend condition may still have been "playing along". In this case, their performance would not represent transfer or learning from pretense; rather, it would merely represent maintenance of the pretend game. However, we do not believe this is likely given several findings from past research. First, children recognize that a person who was not present during a pretend episode will not be aware of the pretend identities and stipulations that were part of the episode (Hickling, Wellman, & Gottfried, 1997; Woolley & Phelps, 1994; Wyman, Rakoczy, & Tomasello, 2009a). Woolley and Phelps (1994) found that children who had pretended with one experimenter that an empty box contained an object, such as scissors, did not give that box to an experimenter who had not been involved in the pretense when they asked for scissors. Therefore, it seems unlikely that children in our study would assume that the second experimenter, who was not present during the demonstration phase, would share in the pretense that the screwdriver was a sprock.

Second, children can keep track of the identity of substitute objects across multiple pretend scenarios (Wyman, Rakoczy, & Tomasello, 2009b); if they were interpreting the test phase as part of the original pretense, they should have all chosen the substitute object from the demonstration phase when asked to find a sprock during test. However, across both studies combined, children in the pretend condition chose this object on only one third of trials, suggesting that the majority of children did not view the test phase as a continuation of the earlier pretend game.

Another possibility is that children may have ignored or forgotten about our relatively subtle pretend manipulation and focused only on what the experimenter told them about sprocks and their functions during the demonstration phase. The experimenter did explicitly demonstrate the function of sprocks in both conditions. It could be that learning in the pretend condition did not represent learning from a pretend context per se but simply represented learning from an adult's demonstration. However, the fact that children in the real condition drew different inferences from children in the pretend condition suggests that the pretend frame did influence how children processed the novel information. In addition, this concern does not apply to the identification trials because children in the pretend condition were not given any explicit information about what a sprock would look like. More to the point, the use of a pretend context did not cause children to quarantine the novel information. Therefore, it is at least possible for children to learn novel information that is presented in a pretend context; whether the pretend context is beneficial for learning is an important avenue for future investigation.

One important caveat to these findings is that although we know that children learned new information about sprocks and coodles, we cannot be sure that children believed they were real objects. Pretense can contain fantastical objects or entities such as dragons and fairies. Children may learn information about these entities (e.g., that dragons breathe fire, that fairies fly) but still know that the entities themselves do not really exist. In the current study, we do not know what judgments children made about the ontological status of sprocks and coodles. They may have learned information about their properties but still believed them to be fictional.

Considering that much research has demonstrated children's skill at keeping pretense and reality separate (Golomb & Galasso, 1995; Sharon & Woolley, 2004; Woolley & Phelps, 1994), how does learning from pretense occur? Here, children learned that sprocks push balls from tubes and are likely to be long and skinny, but they did not simply learn that ''sprock'' is a new label for screwdriver (as children in the real condition did). How did they determine which aspects of the novel information ought to be learned? This task becomes even more difficult when reality and fantasy are intermixed, which frequently occurs during pretense; for example, if a parent and a child are pretending about trains, the child should learn that trains run on tracks and need coal to fuel them but not that trains can talk to one another or drive themselves. To do this, children would need to be able to selectively update their real-world representations based on information in pretend play.

We know that children can selectively update their beliefs about the world from new input. For example, although children can and do learn from others, they take many factors into account before accepting a new piece of information, including the informant's age (Vanderborght & Jaswal, 2009), past accuracy (Koenig, Clément, & Harris, 2004; Koenig & Harris, 2005; Pasquini, Corriveau, Koenig, & Harris, 2007), and access to relevant information (Kondrad & Jaswal, 2012; Nurmsoo & Robinson, 2009; Robinson, Champion, & Mitchell, 1999). If children are similarly evaluating pretend or fictional worlds as possible sources of information, perhaps similar mechanisms operate across the fiction–reality boundary to selectively update beliefs about the real world from information encountered in fictional worlds. Children are selective about which stories they learn from; they are less likely to transfer novel object labels, problem-solving strategies, or causal principles from fantastical or unrealistic stories than from realistic ones (Ganea et al., 2008, 2014; Richert & Smith, 2011; Richert et al., 2009; Walker et al., 2014).

Information presented in pretense may be processed similarly; children may be sensitive to particular factors when determining whether new information ought to be learned. Such factors could include the distance between the pretend world and reality (Weisberg & Goodstein, 2009), the learning context (Woolley & Van Reet, 2006), and the properties ascribed to a novel object during pretense; if the object can perform impossible functions (e.g., flying), children may be less likely to accept it as real (Corriveau, Kim, Schwalen, & Harris, 2009; Shtulman & Carey, 2007; Weisberg & Sobel, 2012). In the current study, the pretend scenario was very realistic, the context was overtly pedagogical, and the novel objects had no fantastical or impossible properties. Thus, performance in situations like this might represent the upper limit of children's learning from pretense, and children might have more difficulty in learning from situations that involve more fantastical elements.

On the other hand, it is possible that the current study underestimated children's abilities. First, natural pretense is much richer, and new information is not presented in isolation but rather embedded in a context that might help children to process it. Second, we highlighted the objects' true functions during the demonstration phase (screwing in a screw with the screwdriver and scooping rice with the spoon), which does not typically happen during natural play settings. By making the typical functions more cognitively available to children, we may have increased the likelihood that they would choose the typical functions during the test phase, thereby underestimating how well they learned the novel information. Despite these factors that might have masked the expected effect, we found a robust difference between our two conditions. This suggests that there may be interesting and important differences between how children learn from pretense and how they learn from reality. Future research should use experimental settings that more closely mirror children's natural experiences to further elucidate their ability to learn from pretense.

A remaining question is whether there is any benefit to using pretend play in order to teach children information. The current studies demonstrate that children *can* learn new information from pretense, but not whether children are *more likely* to learn novel information during pretend play or whether they would remember it longer than children who learned the same information in a real context. Vygotsky (1967) proposed that pretense is a ''zone of proximal development'' where children are capable of more complex thought than they would be otherwise. He also claimed that object substitute play in particular is an important stepping stone toward the development of symbolic reasoning. According to Vygotsky, it is easier for young children to reason about absent objects when there is a physical substitute to serve as a pivot. Thus, it may be easier for children to learn about absent novel objects during pretense because they can initially map their new concept onto the physical substitute. For example, if a child does not know what a rocket is, it may be easier to teach the child by pretending that a soda bottle is a rocket than to talk about rockets with no physical object present to represent one.

Some research has suggested that embedding facts and skills in a fantasy context is helpful for teaching children new information (Cordova & Lepper, 1996; Parker & Lepper, 1992; Wiest, 2001). Indeed, if pretense is not strictly quarantined from reality, it could serve a useful function in the education of young children. Importantly, however, we found that children made different inferences about information learned in pretense compared with information learned in a realistic context. This finding suggests that it will be important for parents and educators to be mindful of how they present new information in pretense in order for children to make the appropriate inferences to reality. Furthermore, as discussed above, the current studies do not show that pretend contexts are *better* than real ones for promoting children's learning. Future research should investigate whether and how pretense could be a more optimal environment for learning. For example, are children more engaged in a pretense learning situation compared with a matched non-pretense learning situation? Do children engage in pretense learning situations more voluntarily than in non-pretense learning situations?

Overall, these experiments suggest that there can be selective transfer of information from pretense to reality. Children learned a novel function taught to them during pretense, and they made inferences about the properties of a novel object based on the characteristics of the pretend scenario. There are still many directions open for future research regarding the nature of learning from pretense such as how long children remember this information, how easily they transfer it to different contexts, whether characteristics of the play partner matter, and how children learn different types of information (e.g., skills, problem-solving strategies). However, the current studies provide support for the idea that pretense can be a valid and useful context for teaching children new information.

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