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# Enabling conditions and children's understanding of pretense

David M. Sobel *

*Department of Cognitive and Linguistic Sciences, Brown University, Box 1978, Providence, RI 02912, United States*

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ABSTRACT

Two experiments examined whether preschoolers' difficulties on tasks that required relating pretending and knowledge (e.g., Lillard, A. S. (1993a). Young children's conceptualization of pretense: Action or mental representational state? *Child Development*, *64*, 372–386) were due to children's inability to appreciate the causal mechanism behind enabling conditions. In Experiment 1, 4-year-olds were told about a character who knew about one kind of animal and did not know about another. The character acted in a manner consistent with both animals. Children were asked whether the character was pretending to be the animal of which he was ignorant. The character's knowledge was either represented in a generic manner (as a picture) or in a manner that suggested a particular enabling condition relation that children found accessible (as a battery, which most 4-year-olds recognize is critical for making toys work). Children were more successful at relating knowledge and pretending in the battery condition. This improvement in performance extended to another task in which children had to identify the enabling condition relation between knowledge and identification, in which there were reduced demands on the inhibitory mechanisms necessary for success. Experiment 2 found that the results in Experiment 1 were not due to demands of the procedure used in Experiment 1. These results are discussed in the context of recent theories of theory of mind that focus on the importance of causal relations among mental states.



## 1. Enabling conditions and children's understanding of pretense

Researchers in theory of mind have paid careful attention to what children know about pretending. Understanding that another person is pretending requires similar representational abilities as understanding that another person has a false belief (Leslie, 1987; Lillard, 1993a, 1993b). In both cases, the other person's actions are contrary to what is expected given the actual state of the world. Children understand that others are pretending by age 3 (e.g., Harris & Kavanaugh, 1993), but they do not normally succeed on standard false belief tasks until later in development (e.g., Wellman, Cross, & Watson, 2001).

One explanation of this discrepancy is that young children recognize the representational aspects of pretending before they recognize the analogous representational aspects of belief (e.g., Leslie, 1987, 1988; Perner, Baker, & Hutton, 1994). Consistent with this approach, preschoolers understand that characters who are pretending are thinking about their pretense (e.g., Bruell & Woolley, 1998; Custer, 1996) and are trying to act like their pretense (e.g., Joseph, 1998; Rakoczy, Tomasello, & Striano, 2004). Several studies also suggest that there is a significant relation between children's pretending or their understanding of pretense and their success on other tasks involving mental representation. For example, the more children engage in pretense (e.g., Astington & Jenkins, 1995; Lalonde & Chandler, 1995; Lillard, 2002), and the nature of that pretense, such as whether children have stable imaginary companions (e.g., Taylor & Carlson, 1997), predicts children's success on standard false belief measures.

But a different line of thought is that children's understand pretense as "behaving as if." On this view, young children base their judgments about pretending on another

* Tel.: +1 401 863 3038; fax: +1 401 863 2255.
*E-mail address:* Dave_Sobel@brown.edu

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person's actions rather than his/her mental states (Harris, 1991; Harris, Lillard, & Perner, 1994; Lillard, 1993a, 1993b, 2001; Perner, 1991). Support for this view comes from Lillard's (1993a) "Moe the troll" task: 4-year-olds tend to judge that someone who is acting like an entity (e.g., Moe the troll, who is hopping like a kangaroo), but who does not know about the entity (e.g., because kangaroos do not exist in the land of the trolls, and Moe has never heard about nor seen one) is pretending to be that entity. These same children typically succeed on standard measures of false belief. Various investigations contrasting a character's actions with their mental states suggest that 4-year-olds have difficulty recognizing that characters are pretending when they act like the pretense entity, but are not engaging in a mental process that is a necessary condition for pretense (Ganea, Lillard, & Turkheimer, 2004; Lillard, 1998; Sobel, 2004, 2007). An understanding of pretense as a mental state, related and dependent on other mental states and not necessarily action, develops around age 7–8 (Lillard, 2001; Richert & Lillard, 2002).

Recently, developmental psychologists have begun to conceptualize how children represent their knowledge of the relations among mental states by considering more generally how children represent the causal structure of a particular domain (e.g., Gopnik et al., 2004; Gopnik & Schulz, 2004, 2007). Applying this approach to pretending, children develop an understanding of how pretending is causally related to other mental states. A simple qualitative version of such a model might include three variables: (1) the intention to pretend to be an entity, (2) knowledge of that pretense, and (3) the action of the potential pretender. The causal relation between the intention to pretend and the pretender's action can be construed as a generative one. An actor with the intention to pretend will act in a manner consistent with that entity (unless particular circumstances prevent this). The relation between knowledge of the pretense entity and the intention to pretend is not generative but rather an enabling condition; knowing about a kangaroo allows but does not compel one to pretend to be a kangaroo. Thus, this causal model relies on children recognizing both an enabling condition relation and direct, generative causality. If children do not enabling conditions, then the Moe task might underestimate children's knowledge.

This argument relies on the assumption that children recognize the direct, generative causal relation between the intention to pretend and action. Several studies suggest that preschoolers recognize that pretenders act intentionally (Bruell & Woolley, 1998; Ganea et al., 2004; Joseph, 1998; Sobel, 2007). For example, Joseph (1998) found that preschoolers judged that someone who was pretending to sneeze actually tried to do so, while someone who really sneezed might not have the intention to sneeze. But one study has found that preschoolers struggled to understand that intentionality was a prerequisite for pretending; Lillard (1998) showed that 4-year-olds claimed that a character who was acting like a pretend entity, but not trying to be that entity, was pretending to be that entity. In a discussion of Lillard (1998) and Joseph (1998), Gopnik (1998) suggested that children could recognize that pretenders intend to act like their pretense, but fail to recognize that in order to be pretending, an agent must intend their action as pretense. This first kind of knowledge is a generative causal relation: if the agent is pretending, then that intention to pretend causes them to act in a particular manner (like their pretense). The second kind of knowledge is an enabling condition: in order to pretend, the agent must intend their actions to be pretense (as opposed to accomplish another goal).

What do 4-year-olds know about enabling conditions in general? By age 4, children can engage in causal inference about embedded rules (such as if a condition is present, then a particular conditional applies, see e.g., Frye, Zelazo, Brooks, & Samuels, 1996; Hughes & Russell, 1993). However, in these studies, children were not asked to reason about the nature of the enabling condition relation. When this is the case, 4-year-olds' understanding appears fragile: Shapiro and Hudson (2004) found that preschoolers' ability to plan and enact events was limited when those events involved many enabling condition relations as opposed to arbitrary relations. More generally, Siegler (1976) found that 5-year-olds have difficulty making inferences about necessity and sufficiency among causal events. Because an enabling condition is necessary for a generative relation to function, but insufficient to produce the effect by itself, these data suggest that young children might have difficulty reasoning about this kind of causal relation.

Do 4-year-olds have any understanding of enabling? Very young children do remember sequences of events better if an enabling condition is present than if events are presented in an arbitrary order (e.g., Barr & Hayne, 1996; Bauer, 1992; Mandler & McDonough, 1995; Wenner & Bauer, 1999). But better memory for sequences of events does not show that children specifically understand *why* certain sequences are easier to remember than others. Anecdotally, however, it is possible that preschoolers understand some kinds of enabling relations. As many parents will attest, children often generate explanations of moving artifacts – particularly electronic toys – in terms of their "batteries." This is often the case when asked to describe what is inside them; Gelman and Gottfried (1996) found that many preschoolers spontaneously referred to artifacts' batteries when asked what makes them go. This is also true in children's everyday conversation.[1] Children

[1] To support this assertion, we ran an informal CHILDES analysis on the transcripts of Adam (Brown, 1973), Abe (Kuczaj & Marastos, 1975), Sarah (Brown, 1973), and Mark and Ross (the *Boys* corpus, MacWhinney, 2000), examining any file in which children were between the ages of 2;6 and 5;0. All five children generated the word *battery*. All did so in relation to making toys or other electronic devices activate. All children also heard one or both of their parents generate this word, again in relation to their effects on toys or other objects. As an example:
Abe (at 3;4):

> CHI: like this # hey the light is burned off the light bulb is burned off.
> FAT: really?
> CHI: yeah.
> FAT: maybe we can fix it.
> CHI: I have another battery we could Daddy # I bought two batteries home.
> FAT: Abe # I don't think it's the battery it's probably the light bulb.This example is particularly important because it suggests that when the child (at age 3) sees a failed causal relation, his first suggestion to fix it involves batteries. The feedback the parent gives confirms that batteries could be a causal factor, but potentially are not in this case.

talk about potential enabling conditions even though they have difficulty reasoning about necessity and sufficiency in explicit circumstances (e.g., Siegler, 1976). "Batteries" might be a particular enabling condition relation to which young children have access.

The present experiments examined whether presenting an enabling condition in a more accessible manner facilitated children's inferences about pretense. In Experiment 1, 4-year-olds were given a variant of the Moe task in which Moe's knowledge was represented as either a battery or as a photograph. The hypothesis behind this manipulation was that the battery condition should allow children better access to their understanding of enabling condition relations, and allow them to recognize the relation between knowledge and pretending. Experiment 2 then investigated whether the results of Experiment 1 stemmed from particular demand characteristics of the experiment.

## 2. Experiment 1

Children were introduced to a character (Moe the troll) who was knowledgeable about one entity and ignorant of another. The character then engaged in an action that gave him the appearance of both entities, and children were asked whether Moe was pretending to be the entity of which he was ignorant. In the procedure, the character's knowledge was represented by a photograph, which was placed on either a battery that was attached to the character or on an index card placed next to the character. This manipulation afforded the opportunity to examine whether representing the character's knowledge as a battery as opposed to a more neutral representation allowed the child to register that knowledge was an enabling condition for pretending. If children recognized that batteries facilitated enabling condition relations, then when the character's knowledge was represented as a battery, children should be more accurate in their response – that is, more likely to recognize the enabling condition between knowledge and pretending.

This procedure (asking whether the character was pretending to be the entity he was ignorant of) was administered to examine the specific role of the battery manipulation. Several investigations have shown that presenting 4-year-olds with these kinds of questions as a 2-alternative forced-choice improves accuracy (e.g., Davis, Woolley, & Bruell, 2002; Ganea et al., 2004; Sobel, 2004, 2007). Although one might construe this procedure as providing children with an "implicit" forced-choice (as there are always two entities, one of which Moe is presumably pretending to be), the goal here was to parallel the original "Moe the troll" task as much as possible; children were specifically asked whether the character was pretending to be a particular entity, of which he was ignorant. Accuracy on that task was approximately 35% (see Lillard, 2001, for a review), which serves as a good baseline for comparison to the present results.

Performance on a task that examined the relation between ignorance and identification (modified from a procedure used by German & Leslie (2001)) was also measured. This task required understanding enabling conditions among mental states to succeed, as one must know about an object in order to recognize it (similar to recognizing that an artist must know about what s/he is drawing, see Richert & Lillard, 2002). Unlike the pretending task, however, there was no conflict between knowledge and action, so this task might not have the same level of inhibitory demands as the pretending task. As a result, performance on this task might better overall, but making the enabling condition relation easier for children to appreciate should also benefit accuracy.

### 2.1. Method

#### 2.1.1. Participants

The sample consisted of 48 4-year-olds (15 boys and 33 girls, $M = 54.71$ months, $SD = 3.87$) recruited from flyers posted at preschools and a list of hospital births. Six additional children were tested but not included: four because of experimenter error, one refused to participate, and one had been diagnosed with a learning disability. The ethnic breakdown of the sample was as follows: 42 children were Caucasian, one was African–American, three were Hispanic, and two were of mixed descent. All children appeared to be from middle- to upper-class SES backgrounds, but no formal measure of SES was administered.

#### 2.1.2. Materials

A small troll doll, 9 cm in height, was used. A 5 cm (long) $\times$ 2 cm (diameter) blue plastic cylinder could be attached to this doll, such that an ordinary AA battery could be inserted into the cylinder, giving the appearance that the battery was plugged into the doll. Ten AA batteries, each with a 2.5 $\times$ 1.5 cm picture of an animal taped to it were used. The pictures were of toy animals, four of which (a duck, cow, mouse, and squirrel, all approximately 5 cm tall) were used in the procedure with two brown paper bags. The other pictures were of a kangaroo, rabbit, dog, cat, bear, and elephant. Ten 12.5 $\times$ 7.5 cm cards with the same 2.5 $\times$ 1.5 cm pictures taped to them were used. Examples of both the batteries and index cards, along with the troll doll, are shown in Fig. 1. A flashlight and 4D batteries (2 charged, 2 dead) were used in the pretest.

#### 2.1.3. Procedure

All children were tested individually with their parent/caregiver present. Half of the children were assigned to the *battery* condition and half to the *picture* condition.

*2.1.3.1. Familiarization.* Children were shown a flashlight. In the battery condition, the experimenter turned it on, but it failed to activate. The experimenter said, "Oh, it must need some new batteries. I have new batteries here." At this point, the experimenter took out two batteries, and changed the batteries inside the flashlight. The flashlight now activated, and children were allowed to play with it. In the picture condition, children were also shown the flashlight, which initially contained working batteries, and they were simply allowed to play with it. This introduction was used in the battery condition to ensure that

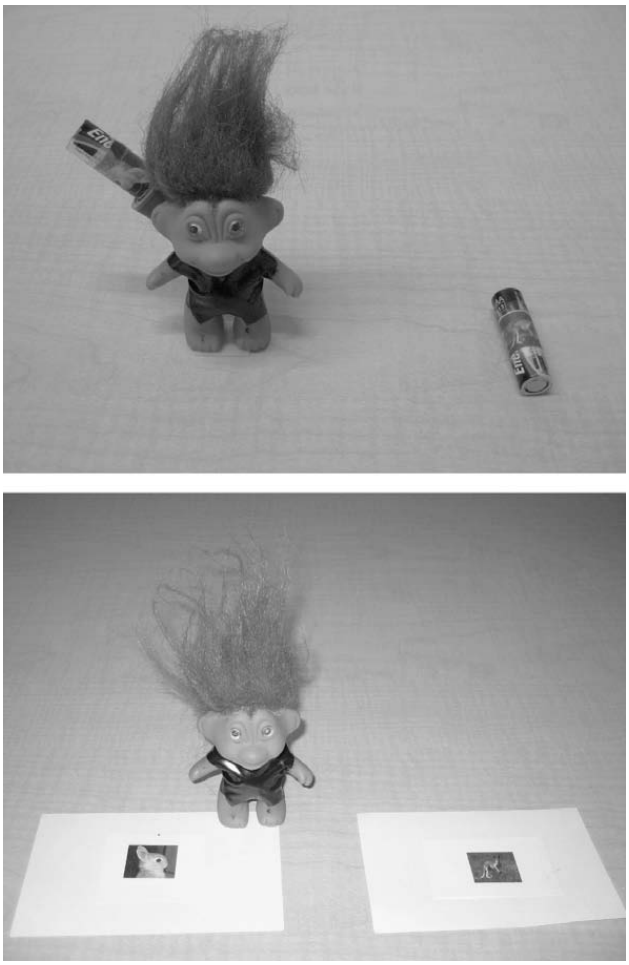

**Fig. 1.** Stimuli used in a pretending trial in the battery (top) and picture conditions (bottom).

all children knew what a battery was, and to highlight their function.

The flashlight was then put away, and the troll doll was brought out. In the battery condition, a cylinder was attached to the back of the doll, which could house a AA battery. In the picture condition, this cylinder was not present. The troll doll was labeled "Moe, from the land of the trolls," and children were told they would talk about things that were and were not in the land of the trolls.

In the battery condition, the experimenter then brought out two AA batteries, one with a picture of a rabbit on it and one with a picture of a kangaroo on it. In the picture condition, the experimenter brought out two index cards with the same pictures on them. The experimenter said, "In the land of the trolls, there are rabbits, but there are no kangaroos." The experimenter showed the child the appropriate picture as he said this. He told the child that Moe knew about rabbits, but not kangaroos. In the battery condition, the experimenter said, "So let's plug the rabbit battery into Moe, because he knows about rabbits." In the picture condition, Moe was placed next to the picture of the rabbit, and the experimenter said, "Let's put Moe here because he knows about rabbits."

Next, the experimenter started to move the doll up and down and said, "Look, Moe is hopping up and down. When he hops, he looks like a rabbit and he looks like a kangaroo. Both rabbits and kangaroos hop like that. When Moe is hopping, he's pretending. He's pretending to be a rabbit." Children were then asked whether they remembered if Moe knew about both rabbits and kangaroos. Children were also asked whether they remembered what Moe was pretending to be. Corrective feedback was provided if children answered incorrectly to any of these questions (it was necessary only once).

*2.1.3.2. Pretending test trials.* Children received two trials in which they were asked to connect Moe's knowledge state with what he was pretending to be. In each, children were told that in the land of the trolls there was one animal, but not another (e.g., dogs, but not cats), so that Moe knew about dogs, but not about cats. In the battery condition, AA batteries with pictures of the animals were produced, and the appropriate battery was placed into Moe's cylinder connected to him (the other was placed on the table, see top picture of Fig. 1). In the picture condition, index cards with the same pictures were produced, and Moe stood next to the appropriate picture (see the bottom picture of Fig. 1). The troll doll was then made to act in a manner that was equally consistent with the two animals. For example, the doll was moved around the table and children were told, "Moe is running on all fours. When he runs like that, he looks like a dog and he looks like a cat. Both dogs and cats run just like that." Children were then asked two control questions, whether he looked like the animal he did not know about when he was running, and whether he knew about the animal he did not know about (order of these questions counterbalanced among children). They were given corrective feedback on these questions if they answered incorrectly. Children were then asked the test question: whether Moe was pretending to be the animal he did not know about. Children were also asked to justify their responses. The order of these two trials and the role of the two animals within each trial (i.e., which animal Moe knew about) was counterbalanced among children.

*2.1.3.3. Knowledge test trials.* The two knowledge trials started in a similar manner as the pretending trials. Children were told that Moe knew about one animal and did not know about another. In the battery condition, the appropriate battery was "plugged" into Moe. In the picture condition, he was placed by the appropriate picture. An opaque brown bag was then produced, and children were shown it contained a toy version of the animal of which Moe was ignorant. The toy animal was placed back in the bag, and children were asked two control questions, whether Moe knew about the animal, and what was in the bag (order counterbalanced among children). Corrective feedback was given if the child answered incorrectly (and the question repeated). Children were then asked the test question, whether Moe knew about what was in the bag. Children were also asked to justify their responses. The order of these two trials and the role of the two animals within each trial (i.e., which animal Moe knew about) was counterbalanced among children. Children always received the two pretense and two knowledge trials blocked

together, but the order of the blocks were counterbalanced across children.

*2.1.3.4. Coding.* Correct/incorrect responses to all the questions were recorded. Justifications for the pretense trials were coded into one of five mutually exclusive categories: (1) I don't know or No Response. (2) That the character did not know about the animal or was pretending to be the alternative.[2] (3) That the character was acting like the animal. (4) That the character was the animal. (e.g., "He's a dog.") (5) An alternative irrelevant justification (e.g., "He likes to be both things" or "He doesn't have a tail").

Justifications for the knowledge trials were coded into one of four mutually exclusive categories: (1) I don't know or No Response. (2) That the character knew or did not know about one of the animals. (3) That there was a particular animal in the bag. (4) An alternative irrelevant justification (e.g., "He doesn't like mice because they chase him."). A research assistant blind to the hypotheses of the experiment coded all of the justifications. A second research assistant (also blind to the hypotheses of the experiment) coded data from 25% of the participants. Agreement was 90%, and disagreements were resolved through discussion with the author.

### 2.2. Results and discussion

Children required corrective feedback on ~8% of the control questions across the pretending and thinking trials, suggesting that they understood the material presented to them. Preliminary analyses revealed that children did not differ in their responses within the two pretending or the two knowledge trials, so these data were combined to form a score between 0 and 2 for the pretending trials and the knowledge trials. Preliminary analyses also revealed that gender did not influence how children responded to either kind of trials. Similarly, children who received the pretending trials first did not respond differently on either type of trial from children who received the knowledge trials first. Finally, which animal Moe knew or did not know about also had no influence on their response to either trial type. Responses to the test question on the pretending and knowledge trials are shown in Table 1.

The number of correct responses for each trial type was analyzed by a 2 (Condition: Battery vs. Picture) × 2 (Mental State: Pretending vs. Knowledge) Mixed Analysis of Variance. Mental state was a within-subject factor and condition was a between-subject factor. This analysis revealed a main effect of mental state, $F(1, 46) = 11.07$ $p < .005$, partial $\eta^2 = .194$ as well as a main effect of condition, $F(1, 46) = 9.14$, $p < .005$, partial $\eta^2 = .166$. No significant interaction was found.

Looking at the individual conditions, children made on average more correct responses on the pretending trials in the battery condition than the picture condition (mean of 1.42 out of 2 or 71% of the time vs. 0.88 out of 2 or 44%), $t(46) = -2.11$, $p < .05$, Cohen's $d = .61$. Children were also more likely to make a correct response on the knowledge trials in the battery condition than the picture condition (mean of 1.88 out of 2 or 94% of the time vs. 1.33 out of 2 or 67%), $t(46) = -2.85$ $p < .01$, Cohen's $d = .82$. In both conditions, children were more successful on the knowledge trials than the pretense trials, $t(23) = -2.41$ and $-2.30$ in the battery and picture conditions, respectively, both $p$-values < .05, Cohen's $d = .72$ and .50, respectively.

**Table 1**
Distribution and summary of responses to the pretending and knowledge trials in experiment 1.

| | # of correct responses | | | | |
|---|---|---|---|---|---|
| | 0 | 1 | 2 | Mean | SD |
| *Battery condition (n = 24)* | | | | | |
| Pretending trials | 4 | 6 | 14 | 1.42 | 0.78 |
| Knowledge trials | 1 | 1 | 22 | 1.88 | 0.45 |
| *Picture condition (n = 24)* | | | | | |
| Pretending trials | 13 | 1 | 10 | 0.88 | 0.99 |
| Knowledge trials | 5 | 6 | 13 | 1.33 | 0.82 |

Performance in both conditions was compared against chance levels of responses (50%). Children in the battery condition were more accurate than chance levels on both the pretending and knowledge trials, $t(23) = 2.63$ and 9.56, both $p$-values < .05. In the picture condition, performance did not differ from chance on the pretending trials, $t(23) = -0.62$, *ns*, while on the knowledge trials, performance was more accurate than chance, but only at a non-significant trend level, $t(23) = 2.00$, $p = .06$. Children's distributions of responses were also considered against chance performance. Children in both the battery and picture conditions generated a distribution of responses that significantly differed from what would be expected by chance on the pretending trials, $\chi^2(2, N = 24) = 14.33$ and 20.92, respectively, both $p$-values < .005. In the battery condition, the majority of children responded correctly on both trials, while in the picture condition, approximately half of the children responded correctly on both trials while the other half responded incorrectly on both trials. The distribution of responses were also different from change on the knowledge trials, $\chi^2(2, N = 24) =$ 56.92 and 11.33, respectively, both $p$-values < .005, where the majority of children responded correctly on both trials.

The distributions of the justifications are shown in Table 2. Although children in the battery condition tended to justify their responses based on the knowledge state of the character approximately 15–20% more often than children in the picture condition, these distributions did not significantly differ between the two conditions on either the pretending or knowledge trials. However, on the pretending trials, when children's justifications were considered as a function of their response to the pretending question, a significant difference between the conditions was found: More children in the battery condition than the picture condition correctly responded to the test question about whether Moe was pretending to be the animal of which he was ignorant and justified their response in terms of the character's knowledge state, 52% vs. 21% of

[2] These two types of justifications were combined because both indicated that the child related the character's actions with their knowledge states. Also included in this code were justifications that did not specifically mention the word "know", but that indicated that Moe did not know about the animal (e.g., "There are no dogs in the land of the trolls").

**Table 2**
Distribution of justifications to pretending and knowledge trials across the experiments.

| | IDK/NR (%) | Knowledge (%) | Act/App (%) | Identity (%) | Irrelevant (%) |
|---|---|---|---|---|---|
| Experiment 1 | | | | | |
| *Battery condition* | | | | | |
| Pretending | 4 | 58 | 15 | 8 | 15 |
| Knowledge | 8 | 56 | [a] | 15 | 21 |
| *Picture condition* | | | | | |
| Pretending | 8 | 38 | 19 | 2 | 33 |
| Knowledge | 8 | 40 | [a] | 8 | 44 |
| Experiment 2 (all pretending) | | | | | |
| Attached | 11 | 39 | 22 | 6 | 22 |
| Unattached | 6 | 44 | 28 | 0 | 22 |

*Notes:* IDK/NR = "I don't know" or No Response. Act/App = Action of Appearance.
[a] This code was not applicable in the Knowledge Trials in Experiment 1.

the time, Mann–Whitney $U = 180.00$, $z = -2.50$, $p < .05$, $r = -0.36$.

These data suggest that 4-year-olds' difficulty on measures that required them to infer whether a character was pretending given a conflict between the character's actions and his mental states might have resulted from 4-year-olds not recognizing that the nature of the causal relation between knowledge and pretending was an enabling relation. When questions were presented in a context that made the enabling relation more available to the children, performance improved. This manipulation was not specific to pretending – children in the battery condition improved when asked to recognize another enabling condition relation – between knowledge of an object and the ability to recognize that object. This suggests that in general children consider the nature of the causal relation among mental states.

An important issue emerges from this experiment: How exactly is the battery condition affording better responses on the test questions? One possibility is that there were particular demand characteristics that differed between the two conditions, which afforded children better understanding. In the battery condition, the representation of Moe's knowledge (i.e., the battery) was actually attached to the character. When the character acted, the battery moved with the character. This might have allowed children to register that the action was consistent with the entity Moe knew about, and thus must indicate that Moe was pretending to be that entity and not the other one. In the picture condition, Moe moved independently of the picture, and children might not have had the same insight. Experiment 2 was designed to consider this possibility; other possibilities will be considered in the Section 4.

## 3. Experiment 2

It is possible that 4-year-olds' superior performance in the battery condition in Experiment 1 stemmed from an artifact in the procedure – the battery was attached to Moe while the picture was unattached. When Moe moved in the battery condition, children might have registered that he was acting like the entity he was knowledgeable of, and thus was not pretending to be the other entity. Experiment 2 was designed with this concern in mind. Children were given a similar procedure to that of Experiment 1. Instead of representing Moe's knowledge with a battery, in this experiment his knowledge was represented by a wooden dowel with a picture of the entity in question. In one condition, the dowel was inserted into the cylinder attached to Moe, such that it moved with the doll; in the other condition, the dowel was placed next to Moe, and was unattached to him. If children responded just on the basis of this association between object and movement, they should be more accurate in the attached condition than the unattached condition. In contrast, if the battery condition in Experiment 1 afforded easier access to children's understanding of enabling conditions, performance in this condition should be superior to performance in the attached condition in this experiment (and there should be no difference between the two conditions here). Because the motivation for this experiment only concerned the pretending trials in Experiment 1, we only focused on this kind of trial here.

### 3.1. Method

#### 3.1.1. Participants

The sample consisted of 36 4-year-olds (24 boys and 12 girls, $M = 53.14$ months, $SD = 4.11$) recruited from flyers posted at preschools, a list of hospital births, and a local children's museum. The ethnic breakdown of the sample was as follows: 25 children were Caucasian, 3 were Asian, and 7 were Hispanic (we did not collect ethnicity information for one child). All children appeared to be from middle- to upper-class SES backgrounds, but no formal measure of SES was administered.

#### 3.1.2. Materials

The same troll doll and cylinder from Experiment 1 was used. Ten wooden dowels, all the same size as a AA battery were used. Each dowel had a $2.5 \times 1.5$ cm picture of an animal taped to it. The animals depicted were rabbit, kangaroo, dog, cat, bear, elephant, bird, bee, fish, and turtle. The first six were the same pictures used in Experiment 1.

### 3.1.3. Procedure

Children were introduced to the troll doll in the same manner as in Experiment 1, and given the same familiarization about his actions, appearance, and pretending. The children who were randomly assigned to the *attached* condition were shown dowels that represented the character's knowledge that were plugged into the cylinder on the character's back. The children who were assigned to the *unattached* condition were shown the same dowels and given the same instructions, but the dowels were placed next to the character on the table.

Thus, during the familiarization phase, children were told "In the land of the trolls, there are rabbits, but there are no kangaroos." The experimenter showed the child the appropriate dowels as he said this. In the attached condition, the experimenter said, "So let's put the rabbit dowel into Moe, because he knows about rabbits, and let's put the kangaroo dowel over here (indicating the opposite side of the table) because he does not know about kangaroos." In the unattached condition, the dowels were placed next to the character on the table, but the language the experimenter used was similar. Next, the experimenter moved the doll up and down and said, "Look, Moe is hopping up and down. When he hops, he looks like a rabbit and he looks like a kangaroo. Both rabbits and kangaroos hop like that. When Moe is hopping, he's pretending. He's pretending to be a rabbit." Children were then asked whether they remembered if Moe knew about both rabbits and kangaroos. Children were also asked whether they remembered what Moe was pretending to be. All children answered these questions correctly, and hence corrective feedback was unnecessary.

There were four pretending test trials, in which the child was told that Moe knew about one kind of animal, but not another (specifically, dogs vs. cats, bears vs. elephants, fish vs. turtles, and birds vs. bees, all pairs counterbalanced). Children were shown dowels for each animal mentioned on that trial. The dowel representing the animal Moe knew about was placed into the cylinder connected to Moe or placed next to Moe on the table, and the dowel representing the animal Moe was ignorant of was placed off to the side of the table, and children were told that these actions were performed because Moe knew about (or did not know about) the animal in question. The child was then told that Moe was acting in a particular manner (running fast on all fours, walking slowly on all fours, swimming in the water, or flying, respectively), which the experimenter demonstrated, and that when the character engaged in this action he looked like both animals mentioned on the trial. Children were then asked the same two control questions as in the pretending trials in Experiment 1 (i.e., whether Moe knew about the animal he did not know about, and whether Moe looked like the animal he did not know about, order counterbalanced, and corrective feedback given if the child answered incorrectly). Children were then asked the same test question as in Experiment 1 – whether he was pretending to be the animal he did not know about. After they responded, children were asked to justify their response.

### 3.2. Results and discussion

Children required feedback on approximately 10% of the control questions during the test phase, suggesting that they understood the instructions and the basic nature of the task. Preliminary analyses revealed that children did not differ in their responses to the pretending question among the four trials, Cochran's $Q(3, N = 36) = 6.00$, *ns*, so these data were combined to form a score between 0 and 4. Neither gender, order, nor which animal Moe knew about affected responses to the pretending questions. The means and distribution of these scores across the two conditions are shown in Table 3.

Responses to the pretending question did not differ between the attached and unattached condition (means of 1.67 and 2.00 out of a possible 4), $t(34) = 0.52$, *ns*. The overall level of response in both conditions was not different from chance expectations (50%), $t(17) = 0.75$ and 0.00 for the attached and unattached conditions, respectively, both *p*-values *ns*. Chi-squared goodness-of-fit tests, however, found that the distribution of responses in both conditions was different than expected by chance responding, $\chi^2(4, N = 18) = 86.59$ and 96.22, respectively, both *p*-values < .001. Inspection of Table 3 suggests that responses in both conditions were bimodally distributed – most of the children responded either correctly or incorrectly on all trials in both conditions.

These results suggest that children in the battery condition of Experiment 1 were not more accurate simply because the battery was attached to the character. To show this formally, we contrasted performance on the pretense trials in the battery condition of Experiment 1 with performance on the attached condition here. This contrasts children's inferences about pretending when the external representation of the character's knowledge is a battery or a dowel but attached to the character. Recall that children in the battery condition of Experiment 1 responded correctly on 71% of the trials, while children in the Attached condition in Experiment 2 (in which the character's knowledge is represented as a dowel) responded correctly on 42% of the trials. A *t*-test on an arcsin transformation of the proportion of correct responses between these experiments showed that 4-year-olds were significantly more

**Table 3**
Distribution and summary of responses to the pretending trials in Experiment 2.

| | # of correct responses | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | Mean | SD |
| Attached condition ($n = 18$) | 9 | 1 | 1 | 1 | 6 | 1.67 | 1.89 |
| Unattached condition ($n = 18$) | 8 | 1 | 0 | 1 | 8 | 2.00 | 1.97 |

accurate in the Battery condition of Experiment 1 than the Attached condition of Experiment 2, $t(40) = 2.07$, $p < .05$, Cohen's $d = 0.65$, with children above chance only in the Battery condition. In contrast, there was no difference in the level of performance between the Picture condition of Experiment 1 (44% accurate) and the Unattached condition of Experiment 2 (50% accurate), $t(40) = -0.36$, *ns*, with children responding at chance levels in both conditions.

Finally, justifications were analyzed in the same manner as in Experiment 1. An undergraduate research assistant coded the entire dataset, and these data were compared with codes generated by the author, who coded 25% of the data (randomly determined). Agreement was 100%. The distributions of the justifications are shown in Table 2. Children did not differ between the distributions of justifications between the two conditions, and appealed to the character's knowledge state approximately 40% of the time in both conditions. As in Experiment 1, we looked at the percentage of trials on which children correctly responded to the test question and justified their response in terms of the character's knowledge state (21% in the Attached condition and 33% in the Unattached condition). This was not significantly different from each other. However, children in the Battery condition of Experiment 1 did this more often than children in the Attached condition of Experiment 2, 52% vs. 21% of the time, Mann–Whitney $U = 62.00$, $z = -4.06$, $p < .05$, $r = -0.63$.[3] In contrast, there was no difference in responses between children in the Picture condition of Experiment 1 and children in the Unattached condition in Experiment 2 (21% vs. 33%), Mann–Whitney $U = 175.00$, $z = -1.10$, *ns*. When all of the data was analyzed together, children in the Battery condition of Experiment 1 were more likely to make this response than children in the other three groups combined, Mann–Whitney $U = 391.50$, $z = -3.37$, $p < .05$, $r = -0.37$.

## 4. General discussion

Two experiments examined children's understanding of the role of knowledge in pretending. Four-year-olds were told about a character who knew about one kind of animal and did not know about another kind of animal. Children did not reliably recognize that the character was not pretending to be the animal he was ignorant of when he acted in a manner consistent with both animals. Thus, the basic finding of these experiments replicates work by Lillard (1993a, 2001), as well as research suggesting the same level of performance when 4-year-olds were given an explanation for the character's actions that was clearly not pretending to be that animal (Richert & Lillard, 2002).

We did find one condition in which 4-year-olds demonstrated this understanding – when the character's knowledge was represented as a battery. In Experiment 1, children were more accurate in this condition than when the character's knowledge was just represented as a picture. Experiment 2 found that this benefit in performance was not due to simple associative information that was inherent to the battery condition, such as that the battery moved with the character when he acted. When the character's knowledge was represented by an unfamiliar object that was the same shape and size as the battery, which was also connected to the character, children did not show this benefit. Their responses were less accurate than in the battery condition.

These data suggest a way of reformulating the "behaving-as-if" hypothesis: young children are influenced by others' actions when making inferences about pretending in the absence of knowledge about the pretense entity because they appreciate the generative causal relation between pretending (i.e., the intention to pretend) and action, but fail to appreciate the particular enabling condition between this intention and the pretender's knowledge state. How this conclusion follows from these data, however, is based on three assumptions, which are detailed below.

*Assumption 1: Children understand causal relations among mental states*. Bartsch and Wellman (1989) and Wellman (1990) suggested that children understand actions as the results of mental states like desires and beliefs through various developmental progressions. Advocates of this "belief–desire" approach to cognitive development tend to emphasize the importance of abstract representations of causal relations among events (e.g., Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1994). But opponents of such an approach to theory of mind also suggest that causal inferences are made among mental states: for instance, German and Leslie (2001) found that 4-year-olds struggled to understand the relation between ignorance and other mental states (e.g., thinking). German and Leslie's results, which are not necessarily consistent with a "theories" approach to theory of mind, do rely on children understanding the causal relation between the two mental states.

Some philosophers have suggested that theory of mind understanding is more about interaction than about taking predictive and explanatory stances about others' behaviors, but even this view explicitly states that such a representation is possible (e.g., Gallagher, 2004). However, Campbell (2007) has recently described ways in which mental states can serve as variables in the kind of "interventionist" causality that underlies the ways in which researchers are conceptualizing children's representation of causal structure (e.g., Gopnik et al., 2004). Further, there have been several attempts to use causal models to explain children's developing performance on theory of mind tasks (e.g., Butterfield, Jenkins, Sobel, & Schwertfuger, 2009; Goodman, Baker, Bonowitz, et al., 2006). These arguments are all in accord with the possibility that this framework can describe interactions among mental states as part of a causal network.

*Assumption 2: The present findings are not due to alternative explanations*. The current data are generally consistent with previous findings on 4-year-olds' understanding of the relation between pretending and knowledge (e.g., Lillard, 1993a). Several researchers have suggested that these experimental procedures make pragmatic demands that are difficult for 4-year-olds, and relaxing those demands – particularly making the test question into a forced-choice

[3] Because the number of trials differed between Experiments 1 and 2, this analysis, and the others reported in this paragraph reflect the results of an arcsin transformation on the data.

in which the child has an explanation for the character's actions – improved performance (e.g., Aronson & Golomb, 1999; German & Leslie, 2001).

The present experiments showed children two animals that Moe could be pretending to be and asked whether he was pretending to be one of them. One could argue that children were given an implicit forced-choice across all of the conditions, which could have improved their performance. However, only in the battery condition in Experiment 1 did they show a benefit. More generally, Lillard (2001) suggested this interpretation is unlikely, and several follow-up procedures have found that even when those particular conditions are relaxed, children's understanding of the enabling condition relation between knowledge and pretending does not improve (e.g., Richert & Lillard, 2002). Further, some have argued that the benefits to performance observed in these studies might be due to the nature of the test question children were asked (e.g., Ganea et al., 2004; Sobel, 2004, 2007); changing the test question might improve performance, but 4-year-olds' understanding is fragile at best.

Another possibility is that children faced different executive demands between the battery condition and the picture condition in Experiment 1 as well as both conditions in Experiment 2. Frye (2000), for instance, suggested that accurate responding on the Moe task required children to inhibit Moe's actions in favor of the mental state knowledge critical for success. It is possible that 4-year-olds understood the nature of the causal relation between knowledge and pretending, and the battery condition simply made these inhibitory demands easier for children, allowing them to respond correctly.

If this were the case, then we should not expect a significant increase in accuracy when those inhibitory demands were already low. Unlike the pretense trials, success on the knowledge trials in Experiment 1 did not require the child to inhibit the character's actions. Performance on these trials was better overall than performance on the pretense trials. However, performance on these trials was only marginally different from chance in the picture condition and showed a significant increase in the battery condition. This suggests that the battery condition is doing more than just relaxing the inhibitory demands in the procedure.

Similarly, Lillard (1993a, Experiment 4) demonstrated that 4-year-olds had similar levels of performance on the standard "Moe" task when children were not shown the potential pretender's action, but rather a still photograph of that agent. This raises the possibility that children might understand the enabling condition relation between knowledge and imagery (i.e., an agent cannot imagine something of which she is unaware) in a similar manner. This is an open question for future research. However, this has been investigated in the context of agents drawing pictures – in order to draw an object, an agent must know what they are drawing, and that their drawing intends to depict that object. Knowledge is an enabling condition for intending to draw. Richert and Lillard (2002) demonstrated that preschoolers do not generally understand this enabling condition relation. Interestingly, when children were asked for the reference of a drawing based on a direct, generative causal relation (i.e., what the agent sees), 2-year-olds had little trouble responding correctly (Preissler & Bloom, 2008). These findings are consistent with the present data.

*Assumption 3: Children can reason about enabling condition relations analogously*. Gentner and Gentner (1983) found that high school students could reason analogously between electronics (including batteries) and other physical-state relations, such as water flow. However, there is less research on young children on this topic, and there does not appear to be a similar study on young children in which batteries are a base structure for analogical reasoning or one using batteries in which the base and target structures are across domains of knowledge. Preschoolers can reason about causal relations by analogy (e.g., Goswami & Brown, 1989; Goswami, Leevers, Pressley, & Wheelwright, 1998; Ratterman & Gentner, 1998). Further, 4-year-olds do understand that there are relational categories inherent among objects (e.g., Angoroo, Gentner, & Klibanoff, 2005) and children recognize such principles in language more generally (Gentner, 2005).

This suggests the possibility that 4-year-olds understand some kinds of enabling condition relations and not others, and might be able to reason about enabling analogously. Consistent with this possibility, Hopkins and Sobel (2007) showed 4-year-olds two kinds of objects each with insides – objects that lacked the efficacy to make a machine go and objects that could do so, dependent on the state of the internal property (which acted as an enabling mechanism). Critically, they manipulated how that inside was labeled. Children struggled when the inside was given a generic label, but when it was labeled a "battery" (even though it did not resemble one perceptually), 4-year-olds responded as if they understood the enabling mechanism. The present experiments asked children to make a similar inference, but across domains of knowledge; they had to recognize that the relation between batteries and their effects on objects was similar to how knowledge affects other mental states. Because there is little similarity between a battery and one's knowledge state, the child might focus on this higher-order enabling relation. While the present data are consistent with this assumption, further investigations are necessary to consider the exact nature of children's analogous reasoning abilities.

A limitation with these data and the present study, however, is that both use a between-subjects design. For example, in the present study, children were only presented with one representation of Moe's knowledge (as a battery, dowel, or picture). It is possible that children in the battery condition in Experiment 1 (and in Hopkins and Sobel's (2007) experiments) specifically knew more about batteries and/or enabling condition relations generally. In the present study, children's individual level of knowledge about batteries was not assessed. However, the short CHILDES analysis presented in Footnote 1 as well as preschoolers' spontaneously appealing to batteries when asked for explanations of why artifacts move (e.g., Gelman & Gottfried, 1996) suggests that this knowledge is generally accessible to preschoolers.

Presenting the character's knowledge as a battery might not be the only way for children to access this enabling condition relation. As a possibility, consider that

4-year-olds have relatively good understanding of the epistemic aspect of intention action (i.e., that intentions are motivated by actors' belief states, see e.g., Moses, 2001). If a character who knows about rabbits but not about kangaroos puts a rabbit mask over his head as opposed to a kangaroo mask and starts to hop up and down, children might be able to recover similar information about the character's actions (i.e., that the character intends to pretend to be a rabbit and not a kangaroo). This might stand in contrast to another condition in which the character takes the same mask and wears it on his arm (or uses it in another unconventional way). In the present experiments, batteries might assist children at recognize the enabling condition between knowledge and pretending, but there is good reason to believe that other manipulations might affect performance in a similar manner. Critically, these manipulations would not necessarily change the format of the test question, the language used to describe the scenario, or the nature of the executive demands inherent to the task.

## 5. Conclusions

Some have argued that measures in which children must infer one mental state from another are misconstrued by young children and as a result object to a behavioral account of children's understanding of pretending more generally (e.g., Friedman & Leslie, 2007; German & Leslie, 2001). Much of this research is consistent with a *Theory of Mind Module – Selection Processor* (ToMM-SP) account of mental state understanding (e.g., Friedman & Leslie, 2004; Leslie, 1987; Leslie & Roth, 1993; Leslie, German, & Polizzi, 2005). This view suggests that children possess concepts of mental states such as pretending at very early ages. Success on tasks that require a representational theory of mind – such as the Moe task or false belief tasks more generally – emerges once children are able to attend to those concepts selectively and process them according to their executive demands.

An alternative to this proposal is that children represent knowledge of mental states in a theoretical manner (Gopnik & Meltzoff, 1997; Perner, 1991; Wellman, 1990, see also Lillard, 2001), and recent accounts of this proposal have focused on how children might represent their causal knowledge (Gopnik et al., 2004; Gopnik & Schulz, 2007). One aspect of this approach is that a representation of causal knowledge support not only children's predictive abilities, but their explanations of events (Wellman & Liu, 2007). An interesting point from these data is made by considering the overall level of 4-year-olds' performance. When the enabling condition relation was presented in an accessible manner, 4-year-olds responded to a task in which mental states conflicted with action above the level of chance but also were likely to justify their responses in terms of the appropriate enabling condition (i.e., the character's knowledge). Such explanatory ability might be more concordant with children representing causal relations among mental states.

While no single experiment or set of experiments can definitively distinguish between these two competing approaches to how children understanding pretending, the present data suggest that pragmatic complexity and executive demands do not solely account for children's difficulty in understanding pretense when mental states and action conflict. These results are consistent with an approach to theory of mind development that suggests children construct a representation of the causal structure among mental states, which has not been the focus of a ToMM-SP approach to theory of mind. Of course, this requires an understanding of what these mental states are. The strength of the ToMM-SP approach is that it posits certain mental state constructs are in place before children come to reason about them explicitly. A theories approach, in contrast, suggests that this understanding develop from active construction given data in the environment and an initial theory, a process that has been underspecified. Although it is possible that the computational models consistent with the theories approach (e.g., Gopnik et al., 2004), might be expanded to posit novel constructs (see e.g., Kemp, Goodman, & Tenenbaum, 2007, for a simulation in another domain), at this point a more conservative conclusion is in order: Both accounts have merit. Children may have an understanding of the pretense concept at very early ages, but develop an understanding of the specific nature among pretense and other mental states as they come to understand the nature of causal relations more generally. A critical prediction of extending the "theories" interpretation of these data, then, would be that teaching children about enabling conditions in general should improve their understanding of specific tasks that require such knowledge. This is an empirical question for further investigation.

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