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Young children's ability to use two-dimensional and three-dimensional symbols to show placements of body touches and hidden objects

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ABSTRACT

In two experiments, we investigated 3- to 5-year-old children's ability to use dolls and human figure drawings as symbols to map body touches. In Experiment 1, stickers were placed on different locations of children's bodies, and the children were asked to indicate the locations of the stickers using three different symbols: a doll, a human figure drawing, and the adult researcher. Performance on the tasks increased with age, but many 5-year-olds did not attain perfect performance. Surprisingly, younger children made more errors on the two-dimensional (2D) human figure drawing task compared with the three-dimensional (3D) doll and adult tasks. In Experiment 2, we compared children's ability to use 3D and 2D symbols to indicate body touch as well as to guide their search for a hidden object. We replicated the findings of Experiment 1 for the body touch task; for younger children, 3D symbols were easier to use than 2D symbols. However, the reverse pattern was found for the object locations task, with children showing superior performance using 2D drawings over 3D models. Although children showed developmental improvements in using dolls and drawings to show where they were touched, less than two thirds of the 5-year-olds performed perfectly on the touch tasks. Both developmental and forensic implications of these results are discussed.

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Introduction

During the past several decades, a great amount of developmental research has focused on children's ability to accurately report prior events (see London & Ceci, 2012). Much of this research has been spurred by actual cases of child sexual abuse that generally are characterized by the absence of physical evidence and eyewitnesses other than the alleged child victims and adult perpetrators. Consequently, researchers have attempted to develop interviewing techniques that reliably elicit complete and accurate accounts from children. The major challenge in this effort has been to identify developmentally sensitive techniques that take into account the social and psychological strengths and weaknesses of children at various ages. In the current experiments, we focused on the developmental requirements for using two common types of forensic interview props. The first study focused on dolls and line drawings. In the second study, scale models of larger objects were added to the research toolkit.

During the past decades, interviewers have used a number of potentially useful but untested techniques with children (see Poole & Bruck, 2012, for a review; see also Poole, Dickinson, Brubacher, Liberty, & Kaake, 2014). For example, during the 1980s, anatomically detailed dolls (AD dolls) were commonly used in the forensic arena. Children were asked to "show what happened" while demonstrating with one or more AD dolls (Boat & Everson, 1986; Conte, Sorenson, Fogarty, & Rosa, 1991; Kendall-Tackett & Watson, 1992). More recently, two-dimensional (2D) human figure drawings (HFDs) have replaced or supplemented the three-dimensional (3D) dolls. In most contemporary HFD-focused interviews, children are shown line drawings of a same-sex child and typically asked to name the body parts. Interviewers then ask the children about touch experiences and invite them to report touch locations by pointing to the drawings.

The conceptual motivation for the use of both AD dolls and HFDs is that such props should help children to overcome linguistic deficits or potential embarrassment that might be associated with disclosing sexual information (Everson & Boat, 2002; Russell, 2008). Another assumption is that AD dolls and HFDs might act as memory cues or reminders for to-be-remembered events while at the same time clarifying for interviewers the names that children use for various body parts (Russell, 2008).

Despite their popularity in the forensic and clinical arenas, there is little empirical support for the primary assumptions just listed above (see Poole & Bruck, 2012, for a detailed review). Some studies have reported that AD dolls increase the amount of information produced by children, although it is at the expense of errors (of touching). For example, Goodman, Quas, Batterman-Faunce, Riddlesberger, and Kuhn (1997) questioned 3- to 10-year-olds who had undergone genital touch during the course of a needed medical procedure. Although the use of AD dolls led to increases in the amount of information provided, the youngest children made more mistakes when using dolls than they did during verbal recall of the event. In fact, when questioned with AD dolls, 3- and 4-year-olds provided as much incorrect information as they did correct information (see also Bruck, Ceci, & Francoeur, 2000; Bruck, Ceci, Francoeur, & Renick, 1995; DeLoache & Marzolf, 1995; Lamb, Hershkowitz, Sternberg, Boat, & Everson, 1996; Steward & Steward, 1996; Thierry, Lamb, Orbach, & Pipe, 2005).

Similar data have been reported for HFDs. For example, in their investigation of 4- to 9-year-olds, Poole and Dickinson (2011) found that HFDs did not affect most aspects of these children's reports about a previously experienced science demonstration. In general, the same amount of information was elicited in the non-HFD interview as in the HFD-focused protocol. There was one exception: The HFD interview resulted in more true and false statements about bodily touch during the open-ended phase of questioning. Other investigators have reported similar results for this age group of children (e.g., Brown, Pipe, Lewis, Lamb, & Orbach, 2007; Bruck, 2009; Poole et al., 2014; Steward & Steward, 1996; Willcock, Morgan, & Hayne, 2006). Thus, although there are sometimes benefits to using HFDs, there are also accompanying risks.

Several explanations may account for the general failure of dolls and drawings to promote children's reports. First, the dolls and HFDs may be suggestive (Bruck, 2009; Bruck et al., 2000; Poole & Dickinson, 2011). Interview props may also be viewed by some children as play objects that may act to encourage the children to thoughtlessly point to body locations (Poole & Dickinson, 2011;

Poole et al., 2014). Another possibility—one that is the focus of the current article—is that for cognitive reasons young children simply struggle to use dolls and drawings to demonstrate where they have been touched. To successfully show where touch occurred on their bodies, children must recall the location of touch and have the ability to accurately transfer that information onto the symbol. In the next section, we review the literature on the age at which children understand dolls and drawings as symbols.

Children show a very early, albeit limited, appreciation of symbols. They begin to recognize objects in 2D pictures at a very early age (Ganea, Allen, Butler, Carey, & DeLoache, 2009; Preissler & Carey, 2004) even when such materials are not available in their cultures (Jahoda, Deregowski, Ampene, & Williams, 1977; Kennedy & Ross, 1975). By 15 to 18 months of age, children understand that a picture stands for something else (Ganea et al., 2009). By the end of the second year of life, toddlers generally do not attempt to pick up and manipulate objects represented by pictures (e.g., they realize that they cannot pick up and eat a picture of a cookie) but rather point to the images in pictures. In addition, by 2 years of age, children engage in pretend play with dolls (Belsky & Most, 1981; but see Tomasello, Striano, & Rochat, 1999, for a discussion of whether children are truly pretending or simply copying previously witnessed actions). Children's early play and exploration of drawings and dolls certainly give forensic interviewers reason to intuit that the props may be helpful in interviews.

In a large body of work, DeLoache and colleagues have shown that symbolic development is not an all-or-nothing attainment. Children's ability to flexibly use symbols continues to develop as a function of the task demands. DeLoache (1987, 1991) argued that, in order to understand a symbolic object (termed *representational insight*), children must mentally represent it as both an *object* and a *symbol* (i.e., they must achieve *dual representation*). DeLoache and colleagues examined children's developing ability to *use* 2D pictures and 3D models as symbols in order to guide their search for an object in a larger space. In their standard task (DeLoache, 1987), a small "Snoopy" doll is hidden in a small-scale model room. The child must use the small-scale model as a symbol to gather information about where the larger doll is hiding in the "big room." DeLoache and colleagues (e.g., DeLoache, 1987, 1991; DeLoache & Burns, 1994; Marzolf & DeLoache, 1994) consistently found that 2.5-year-olds have difficulty in using information from a scale model to guide their search of a larger room, but by 3 years of age most children succeed on the task. However, DeLoache and colleagues identified a number of conditions and parameters that moderate children's symbol performance, including explicit verbal instructions on the task (DeLoache, 1989) and the degree of iconicity between the model and the room (DeLoache, Kolstad, & Anderson, 1991; Ganea et al., 2009). An additional finding from this lab is that, for their standard search tasks, children consistently show an appreciation of 2D symbols before 3D symbols (DeLoache, 1987, 1991; DeLoache & Burns, 1994; Marzolf & DeLoache, 1994).

DeLoache and colleagues' findings imply that, in order for props to bolster forensic reports, children first must acquire the representational insight that dolls or drawings are symbols of themselves. Children also must be able to accurately map from the self to the doll or the drawing. Based on DeLoache's work, one would predict that children would be able to use a drawing before a doll given that the drawing is 2D and serves only a representational function, whereas a doll is both a symbol and a play object with which children can interact (see DeLoache, 1991; DeLoache & Burns, 1993; DeLoache, Pierroutsakos, & Troseth, 1996; DeLoache et al., 1991).

Limited research addresses the age at which children acquire the representational insight that dolls or drawings are symbols of themselves. In one report, DeLoache and Smith (1999) briefly reviewed several of their unpublished studies that examined children's ability to map body touches using dolls and drawings. In one study (Smith, 1995), the researcher placed a sticker on a child and asked the child to indicate the sticker placement on a doll or on a color drawing of the doll. The rates of correct sticker placements were similar for 2.5- to 3.5-year-olds in the doll (62%) and drawing (55%) conditions. Despite the lack of methodological details and statistical analyses, the most interesting finding is that, in this age range, children had great difficulty in mapping their own body parts onto a doll/drawing. Although their paradigm and preliminary findings are intriguing, children's developing ability to use symbols to demonstrate bodily touch has yet to be systematically examined. Such developmental findings not only are important theoretically but also would set some empirically driven guidelines for the appropriate use of various types of props in the forensic arena.

Experiment 1 of the current study was designed to minimize memory demands in order to directly examine children's ability to use dolls and HFDs as symbols to map the location of body touches. Unlike past studies where children used dolls and drawings to recount an earlier event, in this paradigm a sticker remains placed somewhere on the child's body so that memory for the original touching event is not an issue. We sought to directly examine the basic question regarding at what age children can reliably use dolls and drawings to show contemporaneous body touching. Experiment 2 was a replication and follow-up of Experiment 1; we added tasks requiring children to use 2D and 3D symbols to locate the positions of a hidden object.

Experiment 1

Method

Participants

A total of 85 3- to 5-year-old children (M_{age} = 3.94 years, SD = 0.79) were recruited from schools and day-care centers in a large eastern city (n = 41) and a medium-sized midwestern city (n = 44) in the United States. The sample consisted of 29 3-year-olds (16 female and 13 male), 32 4-year-olds (19 female and 13 male), and 24 5-year-olds (15 female and 9 male). Written parental permission was obtained for all participants. The study was approved by our institutional review boards.

Design

A large sticker was placed on a specific location on the child's body. The child was then given a smaller sticker and told to place it on the exact same place on a symbol of the child's body. There were three within-participants touch conditions with four trials each: (a) a human drawing touch task, (b) a doll touch task, and (c) an adult touch task.

Materials

In the drawing task, HFDs were taken from a forensic interviewing manual. The drawings showed the front and back of a child (as is the practice in forensic proceedings). Clothes were drawn onto the HFDs. For the doll task, 22-inch "My Buddy" brand dolls were used. The dolls were fully clothed. Four different dolls and drawings were available so that the props could approximate children for sex and race (male or female, white or black).

Procedures

Children were tested individually during a single 20-min session at a quiet location of their school or day care center. After establishing rapport with children, the testing began.

Human drawing touch task. The researcher showed the child the drawings (front and back), stating that it was like the child in a lot of ways. The child was then asked to point to four specific body parts (e.g., ear, nose, foot, shoulder) on the drawing. For example, the researcher stated, "See, she has an ear. Point to the ear on the drawing." This procedure provided an estimation of the child's ability to locate various body parts on the drawing.

Next, the researcher explained that she was going to place a big sticker on the child. After the placement, the researcher gave the child an identical but smaller sticker and told the child to place it on the drawing in exactly the same place as where the sticker was on the child's body. There were four trials, each for a different body part. All 12 placements were in innocuous locations on the child. Different body parts were used, similar to DeLoache hiding a Snoopy doll in different parts of a room. We did not want to touch the child in the same place repeatedly, which could lead to a response pattern. Although we used different body parts for the doll and drawing, the body parts always appeared in the same order (e.g., elbow, knee, foot). We systematically counterbalanced the order for the tasks (e.g., doll, drawing, adult; drawing, doll, adult) so that the different body parts appeared equally often for each symbol type. This ensured that any differences in performance according to symbol type (e.g., doll vs. drawing) was due to actual differences in these symbolic media versus in certain body parts (e.g., shoulder) being challenging for young children.

Doll touch task. The child was asked to point to four different body parts before starting the task. This task was identical to the previous one except that the child was asked to use a doll as the symbol and there were four new body part placements (counterbalanced across different orders of the symbol tasks).

Adult researcher touch task. This task was identical to the previous two tasks except that four new body part placements were used (again with counterbalanced task orders). In addition, the child was told by the adult researcher to place the sticker "on me in just the same place as it is on you."

Scoring. Correct placements were liberally coded, and responses were scored as correct if the child placed the sticker on the correct location regardless of side (e.g., right hand vs. left hand).

Results

In preliminary analyses, there were no differences based on gender or data collection site, so the data were collapsed across these variables. All analyses were conducted on raw scores, although percentages are reported for ease of reading.

Body part identification

When asked to point to different body locations, regardless of age, children were highly successful with all three symbols (overall 91% accuracy rates) with no age trends. Overall, children understood the names and could point to the parts of the body that were to be touched during the next phase of the study.

Body touch data

A 3 (Age: 3-, 4-, or 5-year-olds) by 3 (Symbol Type: drawing, doll, or adult researcher) repeated measures analysis of variance (ANOVA) with symbol type as a within-participants variable was conducted on the number of correct placements. There was a main effect of age, $F(2,82) = 17.53$, $p < .001$, $\eta^2_p = .30$, and symbol type, $F(2,164) = 7.10$, $p = .001$, $\eta^2_p = .08$. There was also a significant symbol by age interaction, $F(4,164) = 2.66$, $p = .035$, $\eta^2_p = .06$. As shown in Table 1 and confirmed by planned contrasts, the 3- and 4-year-olds made more errors in the drawing task compared with the doll task, $t(60) = -3.46$, $p = .001$, and the adult researcher task, $t(60) = -3.42$, $p = .001$; there were no significant differences between the doll and adult researcher tasks ($p = .91$). The 5-year-olds did not show an effect of symbol condition, performing well across all three symbol tasks. A trend analysis confirmed overall improved linear performance among 3- to 5-year-olds on the symbol tasks, $F(1,84) = 34.93$, $p < .001$.

From a forensic standpoint, any errors at all could be highly costly. That is, if a child falsely points to the genitals when asked whether anyone has touched her or him, this one mistake could set an intense investigation into motion. Therefore, we next examined children's errorless performance on the symbol tasks. See Table 2.

Table 1
Percentages correct on the touch locations tasks by symbol type and age in Experiment 1.

Symbol	3-year-olds	4-year-olds	5-year-olds
Human drawing	44.0	70.3	93.8
Doll	64.7	78.1	93.8
Adult researcher	64.7	78.9	93.8

Table 2
Percentages of children with errorless performance by symbol type and age for Experiment 1.

Symbol	3-year-olds	4-year-olds	5-year-olds
Human drawing	6.9	37.5	75.0
Doll	27.6	50.0	75.0
Adult researcher	24.1	53.1	75.0
Errorless on all three symbols	0.0	28.1	45.8

Does body identification ability predict symbol performance?

Finally, we examined whether children's ability to identify body parts on the symbol predicted their performance on the symbol task. This is an important applied issue because body diagram-focused forensic interviewers tend to commence their interviews by asking children to point to the different body parts on the symbol. The assumption seems to be that if children show that they understand the drawing has the same body parts (e.g., they can point to the hand) as they do, the children should be able to demonstrate the location of touch experiences using the drawing. We examined whether an association existed between children's ability to point to the body parts and their performance on the symbol tasks in three ways. First, we examined whether performance on the body identification task was correlated with performance on the symbol tasks while controlling for age. Bonferroni corrections (for three comparisons) were made due to repeated comparisons. None of the correlations was significant ($rs = .19–.25$). Next, we coded children's body identification into a dichotomous variable according to whether the children scored perfectly in labeling the body parts. We used this variable as a predictor variable (along with age in years) with performance on the symbol tasks as the response variable. Performance on the body identification task did not predict symbol performance (all $Fs < 2.75$, $ps < .10$). Finally, we examined whether performance on the body identification task reduced our odds in predicting performance on the symbol tasks. All lambdas were between 0.00 and 0.16 with all $ps > .10$. By knowing whether a child can identify body parts on a drawing or a doll, we do not reduce our odds in predicting the child's ability to use the prop as a symbol.

Discussion

Our results are interesting in two regards. First, we found significant deficits in 3-year-olds children's ability to use symbols to show body touches. Although performance improved with age, even 5-year-olds made some errors, with slightly less than half of the 5-year-olds showing perfect performance on all three tasks. In contrast, DeLoache and colleagues consistently found that 3-year-olds perform well in using symbols to guide their search of another space. However, our findings are consistent with DeLoache's theoretical framework that children's understanding and use of symbols undergoes extended development and is a function of the properties of the task. In fact, DeLoache and Smith (1999) hypothesized that the ability to use symbols to guide one's search of a larger space might be acquired earlier than the ability to use a symbol to map bodily touch.

A second interesting finding of Experiment 1 was that 3- and 4-year-olds performed better in the doll task compared with the human drawing task. Although the effect size for this finding was relatively modest, the clinical implications are significant given that the findings are in the opposite direction from practice; namely, HFDs have replaced dolls in forensic practice under the assumption that children could use drawings earlier than dolls to show body touch. Our findings suggest the opposite pattern with regard to using forensic interview props to map bodily touch.

Experiment 2 had two objectives. One goal was to replicate the superiority of 3D versus 2D symbols when mapping body touches. Second, we sought to examine children's performance in using symbols to show the location of an object that was placed in a large-scale space (similar to DeLoache & Burns, 1994) versus to map body touch (as was the case in Experiment 1). Although we can conclude from Experiment 1 that children's developmental trajectory was later compared with that in DeLoache's studies, a more compelling design would be to compare symbol performance on an object locations task versus a touch task *within* participants.

Given these considerations, we hypothesized that children would perform better on the object locations task than on the touch locations task, approaching ceiling at an earlier age on the former task. We also hypothesized that on the touch locations task children would again perform better using the 3D symbol compared with the 2D drawing and that the opposite pattern would be found for the object locations task.

Experiment 2

Method

Participants

A total of 97 3- to 5-year-old children (M_{age} = 3.98 years, SD = 0.80) were recruited from schools and day-care centers in a medium-sized midwestern city in the United States. There were 32 3-year-olds (19 female and 13 male), 35 4-year-olds (14 female and 21 male), and 30 5-year-olds (13 female and 17 male). Written parental permission and child assent were obtained for all participants. The study was approved by our institutional review board. All testing was completed during a single 30-min session.

Procedures

The procedures of this experiment were essentially the same as those of Experiment 1 except that an object locations task (similar to that used by DeLoache & Burns, 1994) was included. We also eliminated the adult researcher as a symbol on the touch location task because there was no comparable task that could be created for the object locations task (as further described below). The two tasks were designed to be as comparable as possible in terms of instructions and other cognitive demands.

A second change to the methodology is that half of the children were randomly assigned to receive "don't know" instructions in order to systematically observe whether "don't know" instructions affect children's tendency to use "I don't know" as a response. We found it to be quite surprising in Experiment 1 that children almost always demonstrated a touch location even if they were completely haphazard in their placements. Although we informally observed that children almost never said "I don't know" in Experiment 1, we did not systematically record these responses. In Experiment 2, we added the "don't know" instructions to examine whether such instructions might lessen children's tendency to provide incorrect responses. In forensic interview protocols, children often are given ground rule instructions where the interviewer explains that they can answer "I don't know." In the "don't know" instruction condition, children were told that they might not know the answers to all of the questions and that it was okay to respond by saying "I don't know." They were then given two practice questions in which they did not have the information necessary to answer (e.g., "I have this piece of paper and on the other side is a picture. What is it a picture of?"). If children guessed at the answer, the researcher reminded them that for this question they did not know the answer and so should respond with "I don't know." If children correctly responded with "I don't know," the researcher moved to the next practice question.

Task 1: Touch locations task. As in Experiment 1, each time a new symbol was introduced, the child was asked to identify four body parts. Next, the interviewer placed a sticker somewhere on the child and asked the child to show on a 2D human figure drawing (8 × 11 inches) or a 3D clothed My Buddy brand doll where they were touched. There were four placements for each symbol (for a total of eight placements).

Task 2: Object locations task. This task was designed to be as similar as possible to the touch task and was inspired by DeLoache's Snoopy paradigm, although it was modified to match the touch task as closely as possible. The large-scale space was a child-sized cardboard barn play area (55 inches long × 36 inches wide × 49 inches high). Like the touch task, there were 3D and 2D symbol conditions.

For the 3D object locations condition, the child was shown a small-scale 3D toy barn (13 inches long × 8 inches wide × 10 inches high). As with the touch task, before the test trials the child was asked to identify four barn locations (e.g., point to the barn's roof) on the small-scale barn. Next, the researcher explained to the child that she would hide an apple in or around the big barn. The child's job was to place a small apple replica in the 3D small-scale barn "in just the same place as the *large apple* in the *big barn*."

For the 2D object locations condition, the child was shown 8.5 × 11-inch line drawings (front and back) of the barn. The line drawings were intended to provide a similar amount of detail as the human figure drawings, and both front and back were provided to be consistent with the way in which HFDs are used during forensic evaluation. All barns had an open backside so that the child could easily see and replicate placements made inside the barn. Sufficient detail was provided on the drawings so that the child was able to discriminate the space within the barn from the outside. The child was then asked to identify four different barn locations, similar to naming four body parts for the touch task. After the researcher placed an apple in or around the big barn while the child was watching, she gave the child a small apple sticker and asked her or him to place it in the same place on the 2D barn drawing. Thus, instructions for the touch task and the object locations task were identical with the substitution of the names of the referent and symbols (e.g., "in just the same place as the *big sticker* is on *you*").

Half of the children were randomly assigned to receive the object locations task first, and half received the touch locations task first. For both tasks, symbol presentation was fully counterbalanced across the different locations.

Results

Preliminary analyses revealed that only 6 children responded "I don't know" to the researcher's prompts (4 children who received "don't know" instructions and 2 children who did not receive the instructions). Therefore, the data were collapsed across this variable. All analyses were conducted on raw scores, although percentages are reported for ease of reading.

Body part and barn identification

As in Experiment 1, children in all age groups were highly successful in identifying body parts on both the 2D human drawing and the 3D doll (98–100% correct). Children were also at ceiling pointing to different locations on the 2D barn drawing and the 3D small-scale barn (99–100% correct).

Touch locations and object locations data

A 3 (Age: 3-, 4-, or 5-year-olds) by 2 (Task: touch or object locations) by 2 (Symbol Type: 2D or 3D) ANOVA with repeated measures on the last two factors was conducted on the number of correct placements. As described in the Method section for this experiment, there were four different trials for each of the symbol types (i.e., 2D vs. 3D, for a total of eight placement trials for the touch locations task and 8 placement trials for the object locations task). There was a main effect of age, $F(1,94) = 14.72$, $p < .001$, $\eta_p^2 = .24$, and task, $F(1,94) = 37.92$, $p < .001$, $\eta_p^2 = .29$. There were also two significant interactions: a task by symbol type interaction, $F(1,94) = 16.06$, $p < .001$, $\eta_p^2 = .15$, and a task by age interaction, $F(2,94) = 4.00$, $p = .02$, $\eta_p^2 = .08$. For the touch task, children performed better on the 3D doll ($M = .85$ of the four trials) than on the 2D drawing ($M = .77$ of the four trials), $F(1,94) = 9.75$, $p = .003$, $\eta_p^2 = .09$. For the object locations task, the opposite was true; children performed better on the 2D drawing ($M = .95$ of the four trials) than on the 3D small-scale barn ($M = .90$ of the four trials), $F(1,94) = 7.23$, $p = .008$, $\eta_p^2 = .07$. See Table 3.

Follow-up comparisons of the task by age interaction revealed that the touch task was more difficult than the object locations task for the 3- and 4-year-olds. The 5-year-olds outperformed the younger two age groups and performed comparably across the two tasks. There were also different developmental curves as a function of task. Each task had eight trials. For the more difficult touch task, there was a linear trend, $F(1,96) = 26.20$, $p < .001$ (5-year-olds: $M = .93$; 4-year-olds: $M = .83$; 3-year-olds: $M = .68$). However, for the easier object locations task, the 4- and 5-year-olds performed comparably ($M = .97$ for both age groups) but better than the 3-year-olds ($M = .83$).

Table 3
Percentages correct by task, symbol type, and age for Experiment 2.

Task/symbol	3-year-olds	4-year-olds	5-year-olds
Touch locations			
2D human drawing	64.1	75.7	92.5
3D doll	72.7	89.3	94.2
Object locations			
2D barn drawing	88.3	97.9	98.3
3D small-scale barn	78.1	96.4	95.8

We again examined children's errorless performance on the touch tasks and also on the object locations task. See Table 4.

Does body identification predict symbol performance?

As in Experiment 1, we examined whether children's ability to identify body parts on the symbol predicted their performance on the symbol task in three ways. First, we examined whether performance on the body identification task was correlated with performance on the symbol tasks while controlling for age. Bonferroni corrections (for three comparisons) were made due to repeated comparisons. None of the correlations was significant (*r*s = 0.04–0.16, *p*s > .10). Next, we coded children's body identification into a dichotomous variable according to whether the children scored perfectly in labeling the body parts. We used this variable as a predictor variable (along with age in years) with performance on the symbol tasks as the response variable. Performance on the body identification task did not predict symbol performance (all *F*s < 2.40, *p*s < .10). Finally, we examined whether performance on the body identification task reduced our odds in predicting performance on the symbol tasks. All lambdas were between 0.00 and 0.08 with all *p*s > .10. By knowing whether a child can identify body parts on a drawing or a doll, we do not reduce our odds in predicting the child's ability to use the prop as a symbol.

Discussion

Consistent with the results of Experiment 1, 3- and 4-year-olds performed better using the 3D symbol than using the 2D symbol on the touch locations task. Consistent with our prediction, however, the reverse pattern was shown on the object locations task.

General discussion

Three major findings emerged from Experiments 1 and 2. First, the touch locations task was more difficult than the object locations task, especially for 3- and 4-year-olds. Second, in the touch locations task, children made more errors on the 2D symbol than on the 3D symbol, whereas the reverse pattern was found for the object locations tasks for 3-year-olds. The 4- and 5-year-olds both scored near ceiling on the object locations task and outperformed the 3-year-olds. Third, competence on symbolic

Table 4
Percentages of children with errorless performance by task, symbol type, and age for Experiment 2.

Task/symbol	3-year-olds	4-year-olds	5-year-olds
Touch locations			
2D human drawing	34.4	31.4	70.0
3D doll	43.8	65.7	80.0
Errorless on both symbols	18.8	22.9	63.3
Object locations			
2D barn drawing	65.6	91.4	93.3
3D small-scale barn	46.9	85.7	90.0
Errorless on both symbols	34.4	80.0	86.7

tasks was not categorical and showed different developmental trends as a function of task. Specifically, children showed a later onset of symbol use when mapping touch versus object locations. Children also showed much slower growth in their symbol skills when mapping touch versus objects locations. Even though performance improved with age on the touch tasks, 37% of the 5-year-olds committed at least one error on this liberally coded touch task in Experiment 2. More than 85% of the 4- and 5-year-olds scored perfectly using both the 3D and 2D symbols in the object locations tasks (which parallels DeLoache's body of work). The corresponding percentages of children scoring perfectly using both the 3D and 2D symbols in the touch locations tasks for Experiment 2 were 23% and 63% of 4- and 5-year-olds, respectively. These findings elaborate and qualify those of DeLoache and colleagues, who conducted nearly 30 years of research exploring symbolic development in the context of an object location search task. It is within this framework that we discuss our findings.

First, DeLoache and colleagues consistently have found that children's ability to use symbols to guide their search for hidden objects undergoes rapid development between 2.5 and 3 years of age (DeLoache, 1987, 1991; DeLoache & Burns, 1994; Marzolf & DeLoache, 1994). Our findings identified a later age of competence in using symbols to demonstrate body touch. As has been argued by DeLoache (1987, 1991), symbolic development is not categorical; rather, cognitive skills that underlie flexible symbol use undergo continued development and depend on the nature of the task. Various studies have documented continued development into the school years for flexible symbol use (e.g., Constable, Campbell, & Brown, 1988; Lee, 1989; Liben, Kastens, & Stevenson, 2002).

Second, there is a discrepancy between the results of the current study and those of DeLoache in terms of the relative difficulty of 2D versus 3D symbols. One possible explanation is that our tasks comparing children's performance on mapping body touch versus object locations are not reliable but rather suffer from some methodological flaw. However, the design of Experiment 2 helped to rule out the possibility that some spurious task demands unrelated to the actual mapping of touch were driving younger children's relatively poor performance on the touch locations task and on the 2D (human drawing) condition in that task. In Experiment 2, we designed an object locations task (similar to that used by DeLoache) that was modified to match in every way possible the instructions and other cognitive demands of the touch task. Furthermore, it cannot be argued that children were less familiar with the labels or images of the body touch task than of the locations task. Children's ability to name body parts did not predict their ability to use dolls and drawings as symbols to demonstrate body touch. Even 3-year-olds readily pointed to the correct location on the body when asked to do so (e.g., could point to the elbow on the drawing when asked). There was very little variability in children's body identification performance, with children scoring extremely well in labeling the body parts of the props. This finding mirrors DeLoache's finding (as well as that in Experiment 2) that children can point to similar locations in a small-scale model and a large room, demonstrating that they appreciate the corresponding items (Troseth, Bloom, & DeLoache, 2007). Despite being able to point out the similarity of the spaces, until 3 years of age children do not recognize that they can use information from the scale model in order to guide their search of the referent space. Thus, other factors must be considered in resolving discrepancies between the touch locations and object locations tasks. Below we offer several possibilities.

The first concerns differences in psychological distance in the two tasks. In the object locations task, the child must use symbols to represent psychologically distant spatial entities that are apart from the child. In the touch locations task, the child must integrate her or his own body—the referent—into the mapping task. This may involve a special set of underlying psychological skills, including self-concept or self-awareness, that undergo continuing development throughout childhood (Moore & Lemmon, 2001; Rochat, 2003) as well as theory of mind and perspective taking (i.e., putting themselves apart from the scene to determine what another person would perceive; see Wellman, 2011, for a review). This interpretation is consistent with the long-held view that psychological distance helps children to view an object as a symbol (Langer, 1942; Potter, 1979; Sigel, 1970, 1990; Werner & Kaplan, 1963).

Another explanation is that different parameters of the referent–symbol relationship predict performance in the touch locations and object locations tasks. In the current experiments, because of the close psychological distance in the touch locations task, increased iconicity may be necessary in order to gain representational insight. Interestingly, in the body touch task, the three-dimensionality of the symbols (both the doll and the adult researcher) allowed the children to more easily assess the connection between their own bodies and the symbols. In other words, the factors of iconicity and psychological distance not only may conspire to produce developmental differences between object locations and body touch tasks but also may contribute to differences in the relative difficulty and reverse patterns of 2D versus 3D symbols in each of the tasks. Future studies are needed to elucidate why children perform better when using dolls (3D) over drawings (2D) to map body touch compared with the reverse pattern of the 2D superiority when using symbols to guide their search of a larger space.

Forensic implications

More than 30 years ago, AD dolls emerged onto the forensic scene as interviewers struggled with how to best elicit event reports from children in cases of suspected child abuse. Currently, the popularity of AD dolls has greatly decreased, and dolls have been replaced by HFDs in some of the major interview protocols (see Poole & Dickinson, 2011, for a review). Clinically, the movement away from dolls and subsequent adoption of HFDs among child abuse professionals likely was propelled by data showing that very young children struggled to use 3D objects as symbols and that AD dolls increase errors among preschool-age children. Although there is good reason to suspect that children would perform better using 2D versus 3D symbols (based on DeLoache's body of work), the 3- and 4-year-olds in our experiments found it difficult to demonstrate touch on the human drawings as compared with the dolls. Although children's performance increased linearly with age, even the 4-year-olds' error rate was approximately 25% in showing body touch on the human drawings. Recall in our study that we bypassed memory demands by asking children to show where touch was currently occurring on their bodies. Likely, young children's performance would be worse when adding in factors such as time delay, memory decay, and exposure to post-event misinformation. Unfortunately, interviewers have replaced one developmentally inappropriate task (AD dolls) with another (HFDs), as shown by the results of this study and by those of other researchers (Brown et al., 2007; Bruck, 2009; Poole & Dickinson, 2011; Poole et al., 2014; Steward & Steward, 1996; Willcock et al., 2006; see Poole & Bruck, 2012, for a review).

The findings from our experiments also indicate that child protection professionals cannot assume that children understand the symbolic representational intent of HFDs simply because children can easily label body parts. Even the 3-year-olds in our study readily could point to body parts on dolls and HFDs. However, doing so did not ensure their success in demonstrating on dolls and drawings where touch had occurred on them. By knowing whether a child could successfully label the body parts of the drawings and the dolls, we cannot reliably predict whether they will succeed in using the prop as a symbol.

The major recommendation that emerges from our findings echoes that of past research: Interviewers should commence interviews with open-ended questions that do not rely on props or other types of symbols (e.g., Home Office/Department of Health, 1992; Lamb, Orbach, Hershkowitz, Esplin, & Horowitz, 2007; Lyon, 2005; Poole & Dickinson, 2011; Steward & Steward, 1996). Compared with more directive questions, open-ended prompts produce more substantive and complete reports even from young children (Lamb et al., 2007). The continued use of dolls and HFDs is a potentially dangerous practice and is inconsistent with past and current research examining children's understanding and use of such props.

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