Child Development, January/February 2001, Volume 72, Number 1, Pages 22–36

Biases in Young Children's Communication about Spatial Relations: Containment versus Proximity

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Four experiments examined 3- and 4-year-olds' ability to communicate about containment and proximity relations. One hundred twenty-eight children either described where a miniature mouse was hiding in a dollhouse or they searched for the mouse after the experimenter described where it was hiding. The mouse was always hidden with a small landmark that was either *in* or *next to* a large landmark. When describing where the mouse was hiding, children were more likely to successfully disambiguate the small landmark when it was *in* the large landmark (e.g., under the plant *in* the dresser) than when it was *next to* the large landmark (e.g., under the plant *next to* the dresser). When searching for the mouse, 3-year-olds were faster to initiate their searches when the small landmark was in the large landmark than when it was next to the large landmark. Together, these results suggest that there are informational biases in young children's spatial communication.

INTRODUCTION

Giving and following directions for finding missing objects is a common aspect of everyday communication. Children and adults alike frequently provide and request information about the locations of missing objects such as keys, shoes, and toys. Sometimes a simple description is sufficient to help another person locate a missing object (e.g., "Your shoes are by the front door"). Other times, however, a more complex description is necessary (e.g., "Your shoes are in the closet by the front door"). This is often the case when there are two or more confusable locations in a space (e.g., two or more closets in a house). Much of the research on spatial language, however, has focused on young children's ability to relate a target object to a single landmark or reference object (e.g., Clark, 1980; Johnston, 1984; Johnston & Slobin, 1979). Thus, relatively little is known about young children's ability to produce or comprehend more complex spatial descriptions.

Typically, young children describe the location of a hidden or missing object only in relation to a single landmark (Craton, Elicker, Plumert, & Pick, 1990; Plumert, Ewert, & Spear, 1995). Plumert et al. (1995), for example, asked 3- and 4-year-olds to describe the location of a miniature mouse hidden in a one-room model house. Several pairs of identical small landmarks served as hiding locations. These small landmarks were always placed either on or next to a piece of furniture. Thus, to unambiguously describe the location of the mouse, children had to refer to both the small and large landmarks (e.g., "The mouse is in the *bag* on the *chair*"). Both 3- and 4-year-olds' descriptions almost always included a reference to the small landmark (e.g., "The mouse is in the *bag*"), but 4-year-olds were much more likely than 3-year-olds to also include a reference to the large landmark (e.g., "The mouse is in the bag on the *chair*"). A similar study by Craton et al. (1990) revealed that 6- and 8-year-olds were much more successful than 4-year-olds at describing the location of a hidden toy by relating it to two landmarks (e.g., "It's in the *cup* next to the *red tape*"). Another study of children's ability to describe the locations of hidden objects in their homes showed that by 6 years of age, children often produce hierarchically organized descriptions containing three or more landmarks and spatial regions (Plumert, Pick, Marks, Kintsch, & Wegesin, 1994). For example, a child might describe a location by saying, "It's under a *book* on the *table* in the *kitchen*." Thus, it appears that children progress from describing a target object in relation to a single landmark to describing a target object in relation to two or more landmarks or spatial regions.

A similar picture emerges from studies of young children's comprehension of spatial descriptions. In particular, 3-year-olds have more difficulty than 4- and 5-year-olds following directions that include a reference to more than one landmark (Plumert, 1996). In the Plumert (1996) study, 3-, 4-, and 5-year-olds searched for a miniature mouse in a one-room model house on the basis of the experimenter's descriptions. As in Plumert et al. (1995), several pairs of identical small landmarks served as hiding locations. While children were not watching, the experimenter hid the mouse in a small landmark. Three-year-olds were slower to search for the mouse when the experi-

 0009-3920/2001/7201-0002

menter's description contained a reference to both the small and large landmark (e.g., "The mouse is hiding in the *pot* on the *couch*") than when the description contained a reference only to the small landmark (e.g., "The mouse is hiding in one of the *pots*"). Four- and 5-year-olds searched equally quickly in response to both types of descriptions. Thus, it appears that young children's ability to follow directions that refer to more than one landmark also undergoes developmental change.

One factor that plays an important role in young children's ability to describe a location in relation to a small and a large landmark is the nature of the spatial relation between the two landmarks (Plumert, Carswell, DeVet, & Ihrig, 1995; Plumert et al., 1995). In particular, both 3- and 4-year-olds are more likely to refer to the large landmark when the small landmark is *on* the large landmark (e.g., "The mouse is in the shoe *on* the bed") than when it is *next to* the large landmark (e.g., "The mouse is in the shoe *next to* the bed"). Interestingly, this phenomenon is not restricted to young children's descriptions of location. Plumert et al. (1995) asked adults to learn the locations of a set of objects in a large model house with several rooms and floors. After learning the locations, their task was to write down descriptions of the locations for a naïve listener. Thus, they were free to choose which pieces of spatial information to include in their descriptions. Plumert et al. (1995) found that adults were much more likely to include a small landmark in their spatial descriptions when the target object was *on* rather than *next to* the small landmark. This difference occurred despite the fact that the target object was fully visible both when it was on and when it was next to the small landmark. The fact that both adults and young children show a preference for support relations over proximity relations suggests that the nature of the spatial relation exerts an important influence over the selection of spatial information in descriptions of location.

One question these findings raise is why this preference for support over proximity relations exists. One possibility is that support relations are very salient because they have important functional consequences for how objects interact with one other. In particular, objects fall when surfaces of support are removed. Throughout even the 1st year of life, infants have had many opportunities to observe what happens to an object when a surface of support is removed. Consistent with these ideas, research has shown that very young infants attend to information about support. For example, 4.5-month-old infants look longer when an object remains suspended in midair with no apparent source of support (Needham & Baillargeon, 1993). By 8 to 10 months of age, infants use support relations in their means–end behavior (Willats, 1990). Thus, 8- to 10-month-old infants will pull on a cloth to retrieve an object that is placed on the cloth but is out of reach. Everyday experiences with observing how objects interact may serve to increase the salience of support relations.

The idea that functionality plays an important role in how young children communicate about location suggests that other functional spatial relations beside support should also have an advantage over proximity. One other spatial relation that has important consequences for how objects interact is containment. Like support, containment has implications for how objects move in the environment. For example, when toys are placed inside a box, the toys move when the box moves. Likewise, when a child gets into a car, the child moves when the car moves. Research to date suggests that understanding of containment develops over the first 2 years of life (Aguiar & Baillargeon, 1998; MacLean & Schuler, 1989). MacLean and Schuler (1989), for example, investigated 14- and 20-month-old infants' understanding of the features of containers. Infants watched sand being poured into and out of a cylinder, and then the cylinder was revealed either to be a can (possible event) or a tube (impossible event). Only the older children looked reliably longer when the tube was revealed than when the can was revealed, suggesting that infants have some understanding of containment by 20 months of age. Caron, Caron, and Antell (1988) reported similar results on infants' understanding of the nature of containment. They found that infants began to look longer at violation events (i.e., a can failing to contain an object or a tube containing an object) at around 17 months of age.

The goal of the present investigation was to further examine the role of spatial relations in young children's ability to comprehend and produce spatial descriptions involving two landmarks. Specifically, young children's abilities to produce and comprehend spatial descriptions involving either a containment or a proximity relation between a large and a small landmark were contrasted (e.g., "It's under the towel *in* the playpen" versus "It's under the towel *next to* the playpen"). In this investigation, children either gave or followed directions for finding a miniature mouse hidden in a small dollhouse. Several pairs of identical small landmarks served as hiding locations (e.g., bags, boxes, plants). The mouse was always hidden with one member of a small landmark pair, whereas the other member of the pair remained empty. The target member of the pair was either *in* or *next to* a large furniture landmark (e.g., crib, playpen, dresser).

Thus, to disambiguate the identical small landmark pairs, children had to attend to the spatial relation between the small and large landmarks (e.g., "The mouse is in the box *in* the crib"). In the direction-giving task, children helped the experimenter hide the mouse and then gave directions for finding the mouse to a small doll figure. In the direction-following task, the experimenter hid the mouse while children were not watching and then gave them directions for finding the mouse. The child's task was to find the mouse on the first try.

We hypothesized that children would be more likely to unambiguously describe the location of the mouse when the small landmark was *in* the large landmark than when it was *next to* the large landmark. Likewise, we expected that children would be faster to search for the mouse when the small landmark was *in* the large landmark than when it was *next to* the large landmark. That is, we expected that children would be more successful in giving and following directions when a functional spatial relation (i.e., containment) held between the small and large landmarks than when a nonfunctional spatial relation (i.e., proximity) held between the two landmarks.

EXPERIMENT 1

Method

Participants

Participants were sixteen 3-year-olds and sixteen 4-year-olds from predominantly middle- to upper-middle-class European American families. The mean ages were 3 years, 7 months (*range* = 3,6–3,9) and 4 years, 7 months (*range* = 4,4–4,8). There were 7 males and 9 females in the 3-year-old group and 8 males and 8 females in the 4-year-old group. The children were recruited through a child participant database maintained by the Department of Psychology at the University of Iowa. Parents received a letter describing the study followed by a phone call inviting them to participate.

Apparatus and Materials

A 22-inch-wide × 12-inch-deep × 12-inch-high model room designed to look like a baby's bedroom was used as the experimental space (see Figure 1). A miniature mouse served as the target hidden object, and a 1.5-inch-high troll figure served as the listener. Within the room were eight pairs of identical small landmarks that served as hiding locations. These included pillows, bags, trashcans, towels, boxes, teddy bears, plants, and shoes. Four pieces of furniture served as large landmarks: a crib, playpen, dresser, and a basket. Each of the four furniture items served as a large landmark for two target small landmarks. One of these small landmarks was placed *in* the piece of furniture and the other was placed *next to* and touching the furniture item. Therefore, all locations involved contact between the small and large landmarks, but four involved the relation of containment and four involved the relation of proximity. The nontarget member of each small landmark pair was placed on the floor approximately 5 inches from the target member of the pair. The small landmark that was placed in or next to each large landmark was counterbalanced across children. For example, either the pillow was next to the crib and the diaper box was in the crib, or the diaper box was next to the crib and the pillow was in the crib. This was done to ensure that any differences in performance were due to the

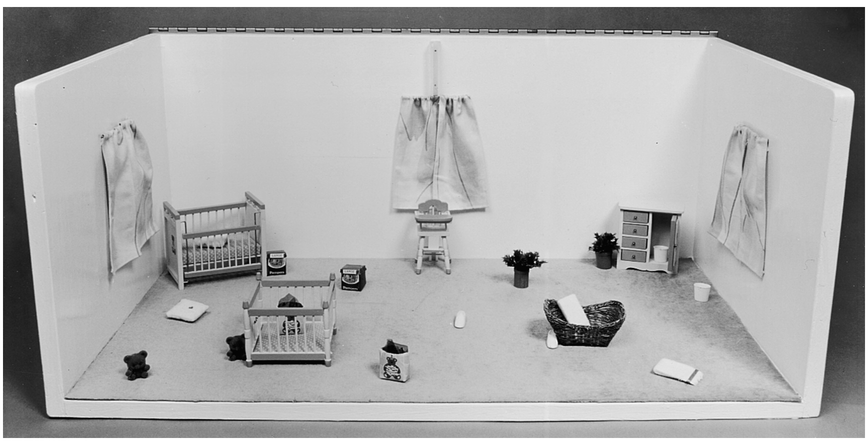

Figure 1 Dollhouse used as experimental space in Experiments 1 and 2.

spatial relation rather than to specific pairings of small and large landmarks. A Plexiglas cover that could be raised and lowered over the front of the house was used to prevent children from pointing directly at locations or retrieving the mouse before they described its location. The dollhouse was placed on a low table and the child was always seated directly in front of it. The experimenter sat on the child's left side. The entire session was videotaped with a Panasonic camcorder positioned above the dollhouse.

Design and Procedure

Children were tested individually in the laboratory. During familiarization with the dollhouse, children were shown the troll figure and told that they would be giving directions to the troll about how to find a mouse in the dollhouse. Children then were familiarized with all of the objects in the dollhouse by being asked to name each item in a random order. If children could not name an item, the experimenter supplied the label and later questioned them about that item to make sure they remembered its name.

Spatial communication task. After familiarization, children were instructed that the troll would hide behind the dollhouse while they hid the mouse with the experimenter. The troll would then come back to the front of the house, and they would try to tell the troll exactly where the mouse was hiding. Children first were given a practice trial in which they hid the mouse on the seat of the high chair and were asked to describe its location to the troll. The high chair was not used as a hiding location for any of the test trials.

There were eight test trials involving the eight target small landmarks. Four of the locations involved the spatial relation of containment and four involved the relation of proximity. The order in which children described the hiding locations was randomized across participants. For each trial, the experimenter put the troll behind the dollhouse and then touched the hiding location with a pencil and instructed the child: "Put the mouse right there." For all locations, the mouse was completely hidden from view. After the mouse was hidden, the experimenter closed the cover and reminded the child not to point at the mouse's location. Children were also instructed to either cross their arms or sit on their hands. The experimenter then brought the troll to the front of the dollhouse and asked the child to tell the troll where the mouse was hiding. The delay between when the child finished hiding the mouse and the experimenter finished asking the child to describe the location was approximately 10 s. If the child's description was inadequate to specify the mouse's location precisely, the experimenter would give a series of structured prompts to the child for more information. The first prompt was always, "Can you tell the troll more about where the mouse is hiding?" If the child provided only the small landmark (e.g., "it's under the bear"), the experimenter followed up the first prompt with, "Can you tell the troll where the (small landmark) is?" If the child provided only the large landmark (e.g., "it's in the crib" or "it's by the playpen"), the experimenter would say, "Can you tell the troll where in/by the (large landmark) the mouse is?" If the child's directions were ineffective after these prompts, the experimenter would open the room and ask the child to retrieve the mouse. This procedure was repeated for all eight test trials.

Object replacement task. Children also performed a second task of replacing the small landmarks that had served as hiding locations in the communication task. Children were instructed to go behind the dollhouse and face the opposite direction. While children were facing away, the experimenter removed the eight target small landmarks from the dollhouse and placed them in a cluster in front of the dollhouse. Children were then called back and asked to put the objects back exactly where they were before. Only the small landmarks that served as hiding locations in the communication task were used to ensure that children had previously experienced equal opportunity to attend to the objects in question. Again, four of these locations involved the relation of containment and the other four involved the relation of proximity.

Coding

Spatial communication task. All descriptions were transcribed verbatim and coded for presence or absence of the targeted information. The following aspects of children's communication were coded: (1) small landmark references, (2) large landmark references, (3) containment terms, and (4) proximity terms. As in Plumert et al. (1995), only small and large landmarks produced spontaneously and in response to the first prompt (i.e., "Can you tell the troll more about where the mouse is hiding?") were coded. On average, children were prompted on 74% of containment trials and on 83% of proximity trials. An Age (3 versus 4 years) × Spatial Relation (containment versus proximity) repeated measures ANOVA with the first factor as a between-subjects factor and the second as a within-subjects factor revealed a significant effect of spatial relation, $F(1, 30) = 4.79$, $p < .05$, indicating that children received significantly more prompts on proximity trials than on containment trials.

A small landmark reference was coded as present when children mentioned or described the object with which the mouse was hidden (e.g., "The mouse is in the *bag*" or "The mouse is in the *party thing*"). Children received two small landmark scores. One represented the percentage of trials in which children mentioned the small landmark when the small landmark was *in* the large landmark and the other represented the percentage of trials in which children mentioned the small landmark when it was *next to* the large landmark.

A large landmark reference was coded as present when children mentioned or described the object with which the small landmark was placed (e.g., "by the *dresser*" or "next to *the drawers*"). Although children sometimes referred to the small and large landmarks in a single description, the two were often produced separately. For example, it was not uncommon for children to give the small landmark spontaneously and to provide the large landmark in response to a prompt. Children were given credit for a large landmark reference in either case. Children received one large landmark score that represented the percentage of trials in which they mentioned the large landmark when it contained the small landmark and another large landmark score for the percentage of trials in which they mentioned the large landmark when it was next to the small landmark.

A containment term was coded as correct when children used the words "in" or "inside" to describe the relation between the small and large landmark when the small landmark was in the large landmark. A proximity term was coded as correct when children used the words "by," "next to," "beside," "near," or "at" to describe the relation between the small and large landmark when the small landmark was next to the large landmark. Coding of children's production of containment and proximity terms was based on the information conveyed after all prompts were given. Children's responses to specific prompts were included to increase the sample of containment and proximity terms. Children received one score representing the percentage of trials in which they produced an appropriate containment term and another score representing the percentage of trials in which they produced an appropriate proximity term.

Intercoder reliabilities were calculated on eight randomly selected protocols by using exact percent agreement. Exact percent agreement for small landmarks mentioned, large landmarks mentioned, proximity terms, and containment terms were 95%, 94%, 100%, and 100%, respectively.

Object replacement task. Small landmark replacements were also coded as correct or incorrect and analyzed as percentages. A containment replacement was coded as correct when children placed the object in the correct landmark, and a proximity replacement was coded as correct when children placed the object closer to the correct landmark than to any other nearby object. Reliability estimates for correct replacements were calculated by using exact percent agreement from videotapes of eight children's landmark placements. Reliability was 98%.

Results

Spatial Communication Task

References to the small landmark. An initial analysis was conducted to determine whether children's references to the small landmark differed by age or spatial relation. (Power analyses were conducted for all effects reported in this paper. Coefficients ranged between .50 and 1.00.) Small landmark scores were entered into an Age (3 versus 4 years) × Spatial Relation (containment versus proximity) repeated measures ANOVA with the first factor as a between-subjects factor and the second as a within-subjects factor. Although references to the small landmark were very high overall, there was a significant main effect of spatial relation, $F(1, 30) = 19.15$, $p < .001$. Children were more likely to mention the small landmark when it was *next to* the large landmark, $M = 100\%$, $SD = 0$, than when it was *in* the large landmark, $M = 87\%$, $SD = .18$.

References to the large landmark. Children's references to the large landmark were examined to test the hypothesis that children are more likely to refer to a large landmark when it contains the small landmark than when it is next to the small landmark. Large landmark scores were entered into an Age (3 versus 4 years) × Spatial Relation (containment versus proximity) repeated measures ANOVA. As expected, this analysis yielded a significant effect of spatial relation, $F(1, 30) = 26.18$, $p < .001$. Children were much more likely to refer to the large landmark when it contained the small landmark, $M = 64\%$, $SD = .36$, than when it was next to the small landmark, $M = 37\%$, $SD = .41$.

References to both the small and large landmarks. The finding that children referred more often to the large landmark when it contained the small landmark than when it was near the small landmark suggests that children find it easier to communicate about containment relations than about proximity relations; however, given the fact that children showed the opposite pattern for small landmarks, it is possible that they chose to give the small landmark for proximity locations and the large landmark for containment locations. Both types of descriptions are ambiguous, however. Providing only the small landmark fails to disambiguate it from the other identical small landmark and giving only the large landmark makes it unclear exactly where inside the large landmark the mouse is located. Therefore, to test whether children were more successful in disambiguating containment than proximity relations, it was important to determine whether children were more likely to provide *both* the small and large landmarks in their descriptions when the small landmark was *in* the large landmark than when it was *next to* the large landmark. Scores representing the percentage of trials in which children mentioned both the small and large landmarks were entered into an Age (3 versus 4 years) × Spatial Relation (containment versus proximity) repeated measures ANOVA. This analysis yielded a significant effect of spatial relation, $F(1, 30) = 10.57$, $p < .01$. Children were more likely to refer to both landmarks when the large landmark contained the small landmark, $M = 51\%$, $SD = .40$, than when it was near the small landmark, $M = 37\%$, $SD = .41$. This analysis clearly shows that children find it easier to communicate about containment relations than about proximity relations.

Use of spatial terms. One issue that remains is whether children's difficulty with proximity relations was due to a problem with mapping proximity terms onto the correct conceptual referents. This issue was addressed by comparing children's accuracy in producing containment and proximity terms. In other words, when children referred to the spatial relation between a small and large landmark, did they use the correct spatial term? Spatial term scores were entered into an Age (3 versus 4 years) × Spatial Relation (containment versus proximity) repeated measures ANOVA. (Five children were omitted from this analysis because they provided no large landmarks for any of the containment trials or for any of the proximity trials). Although children were somewhat more accurate in their references to containment, $M = 99\%$, $SD = .05$, than to proximity, $M = 90\%$, $SD = .28$, terms, the difference was not statistically significant, $F(1, 25) = 2.84$, $p > .10$. Thus, it appears that the difference in children's references to containing versus proximal large landmarks was not due to a difficulty with mapping proximity terms onto their correct referents.

Memory Task

The purpose of the memory task was to assess whether children were more likely to remember small landmark locations when small landmarks were *in* large landmarks than when they were *next to* large landmarks. The mean percentage of correct replacements for the two types of locations was entered into an Age (3 years versus 4 years) × Spatial Relation (in versus next to) repeated measures ANOVA. This analysis yielded a significant main effect of age, $F(1, 30) = 5.25$, $p < .05$. Four-year-olds, $M = 95\%$, $SD = .66$, correctly replaced a higher percentage of small landmarks than did 3-year-olds, $M = 80\%$, $SD = .94$. There was also an effect of spatial relation, $F(1, 30) = 6.03$, $p < .05$. Children correctly replaced a higher percentage of small landmarks when they were in the large landmarks, $M = 91\%$, $SD = .75$, than when they were next to the large landmarks, $M = 82\%$, $SD = 1.1$. Thus, the nature of the spatial relation between the small and large landmarks also affected children's memory for the location of the small landmark.

Discussion

The results of this experiment clearly show that children were more likely to refer to large landmarks when the small landmarks were *in* the large landmarks than when they were *next to* the large landmarks. Likewise, children were more likely to remember the locations of the small landmarks when they were *in* large landmarks than when they were *next to* large landmarks. These results are consistent with earlier findings showing that 3- and 4-year-olds are more likely to disambiguate two identical small landmarks by referring to another, larger landmark when the target small landmark is *on* rather than *next to* the large landmark (Plumert et al., 1995). Thus, it appears that the early bias for support over proximity relations extends to containment relations as well.

The goal of Experiment 2 was to determine whether this preference for containment over proximity also exists in young children's ability to follow directions involving more than one landmark. In this study, the experimenter hid the mouse while children were not watching and then gave them directions for finding the mouse (e.g., "The mouse is in the plant by the dresser"). The mouse was always hidden with one member of a small landmark pair. These target small landmarks were either *in* large landmarks or *next to* large landmarks. Thus, half of the directions involved a containment relation between the small and large landmark (e.g., "The mouse is under the bear *in* the playpen"), and half involved a proximity relation (e.g., "The mouse is under the towel *by* the basket"). A possible preference for containment over proximity was assessed by using two kinds of measures. Search accuracy provided a more gross measure of children's information processing; search latency provided a more subtle measure of information processing. Because the task of following directions is more simple than the task of producing directions, it was expected that any advantage of containment over proximity would be more apparent in children's search latencies than in their search accuracy.

EXPERIMENT 2

Method

Participants

Participants were sixteen 3-year-olds and sixteen 4-year-olds from predominantly middle- to upper-middle-class European American families. The mean ages were 3 years, 6 months (*range* = 3,5–3,11 and 4 years, 6 months (*range* = 4,0–4,8). There were 10 females and 6 males in the 3-year-old group and 7 females and 9 males in the 4-year-old group. Children were recruited in the same manner as in Experiment 1.

Apparatus and Materials

The dollhouse was the same as that used in Experiment 1 except that the Plexiglas cover was removed so that children could easily reach into the dollhouse while searching for the mouse. Again, eight pairs of identical small landmarks served as hiding locations and four pieces of furniture served as large landmarks. As in Experiment 1, each of the four furniture items served as a large landmark for two target small landmarks. One of these small landmarks was placed *in* the piece of furniture, and the other was placed *next to* and touching the furniture item. Therefore, all locations involved contact between the small and large landmarks, but four involved the relation of containment and four involved the relation of proximity. The nontarget member of each small landmark pair was placed on the floor approximately 5 inches from the target member of the pair. Again, the small landmark that was placed in or next to each large landmark was counterbalanced across children. A chair was placed behind the dollhouse facing the wall so that children could not watch the experimenter hide the mouse. The child always stood directly in front of the dollhouse while searching for the mouse. The experimenter sat to the left of the dollhouse. The entire session was videotaped with a Panasonic camcorder positioned above the dollhouse.

Design and Procedure

Children were tested individually in the laboratory. As in Experiment 1, the experimenter first familiarized children with all of the objects in the dollhouse by asking them to name each item. After familiarization, the experimenter told children that they would be playing a hiding and finding game together. For each trial, children were asked to sit in a chair behind the dollhouse while the experimenter hid the mouse. For all locations, the mouse was completely hidden from view. After the mouse was hidden, the experimenter called children back and positioned them directly in front of the dollhouse. The experimenter explained that she would tell them where the mouse was hiding and that they could look for the mouse as soon as the experimenter finished telling them where the mouse was hiding. The experimenter asked children, "Are you ready?" and then described the location of the mouse. The directions were in the form, "The mouse is hiding in the (small landmark) in/by the (large landmark)." Children first were given a practice trial in which the experimenter hid the mouse in a high chair while children were not watching and then gave them directions for finding the mouse (i.e., "The mouse is hiding in the high chair"). After children retrieved the mouse, the experimenter stressed again to the children that they could get the mouse out of the dollhouse right away after the experimenter gave the directions. The high chair was not used as a hiding location for any of the test trials.

There were eight test trials involving the eight small landmarks. Each of the eight target small landmarks served as a hiding location for the mouse. For half of the locations, the experimenter hid the mouse with a small landmark that was *in* a large landmark, and for the other half, the experimenter hid the mouse with a small landmark that was *next to* a large landmark. Thus, half of the directions referred to a containment relation between the small and large landmarks (e.g., "The mouse is in the bag in the playpen"), and half referred to a proximity relation between the small and large landmarks (e.g., "The mouse is in the bag by the playpen"). To disambiguate the target small landmark from its nontarget partner, children had to attend to the spatial relation between the small and large landmarks. The order in which the experimenter hid the mouse at the eight locations was randomized across participants.

Coding and Measures

Children's search accuracy was coded to provide an overall picture of their ability to follow the directions. A search was coded as correct if children looked for the mouse in the correct location on the first try. Two accuracy scores were calculated for each child: one represented the mean percentage of correct searches for containment trials (out of 4), and the other represented the mean percentage of correct searches for proximity trials (out of 4). Intercoder reliability for search errors was calculated on 25% of the sample by using exact percent agreement. Intercoder agreement was 100%.

Search latencies were coded to determine whether children searched faster on containment trials than on proximity trials. Using a computer-generated timing program, search latencies were coded for each of the eight test trials. Latencies represented the time interval between the end of the experimenter's description and the moment when the child touched an object in the dollhouse. Nine trials (out of 256 observations) were removed before analysis because the experimenter prompted the child to look for the object after the directions were given. Six (67%) of these prompts occurred on proximity trials. Typically, prompting occurred because the child sat for quite some time without initiating a search for the object. The mean latency for such trials was 21.95 s. From the remaining data, search latencies for each age group that were three or more standard deviations greater than the mean for each type of trial (i.e., containment versus proximity)were also identified. These latencies were classified as outliers and removed prior to analysis. The total number of outliers removed for 3- and 4-year-olds out of 256 observations was 3 and 4, respectively. Two search latency scores were calculated from the remaining data. One represented the average search latency for containment trials and one represented the average search latency for proximity trials. Intercoder reliability for search latencies was calculated on 25% of the sample by using Pearson correlations. Agreement was very high, $r = .997$, with a mean difference between coders of 224 ms.

Results

Search Accuracy

An initial analysis was carried out on children's search accuracy to determine whether children had more difficulty locating the mouse on the first attempt when the small landmark was *next to* the large landmark than when it was *in* the large landmark. Mean accuracy scores were entered into an Age (3 years versus 4 years) × Spatial Relation (in versus by) repeated measures ANOVA with the first factor as a between-subjects factor and the second as a within-subjects factor. This analysis yielded no significant effects. Children found the mouse on the first try on 89%, $SD = .14$, of containment trials and on 91%, $SD = .18$, of proximity trials. Thus, there was no evidence of bias in the accuracy of children's searches.

Search Latencies

The primary analysis focused on the question of whether children were faster to search in response to directions involving a containment relation between the small and large landmarks than a proximity relation between the small and large landmarks. Mean search latencies were entered into an Age (3 years versus 4 years) × Spatial Relation (in versus by) repeated measures ANOVA. This analysis yielded a significant Age × Spatial Relation interaction, $F(1, 30) = 6.56$, $p < .05$. Simple effects tests revealed a significant effect of spatial relation for 3-year-olds, $F(1, 15) = 10.13$, $p < .01$, but no effect of spatial relation for 4-year-olds, $F(1, 15) = .28$, *ns* (see Figure 2). Three-year-olds took longer to find the mouse when the small landmark was next to the large landmark than when the small landmark was in the large landmark. In percentage terms, 3-year-olds' search latencies for containment locations were 22% faster than their search latencies for proximity locations. For 4-year-olds, however, the difference was negligible. Thus, the nature of the spatial relation between the small and large landmarks influenced younger, but not older, children's ability to follow directions for finding a hidden object.

Discussion

When given directions for finding the mouse, children had to use the information about the spatial relation between the small and large landmarks to determine which of the two identical small landmarks was the correct hiding location. Clearly, children's ability to find the mouse on the first try was not influenced by trial type. Younger children, however, found

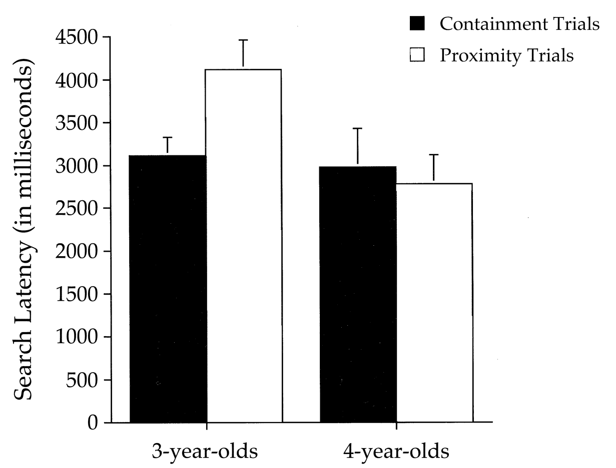

Figure 2 Mean search latencies by age and spatial relation in Experiment 2.

the mouse more quickly when the large landmark contained the small landmark than when it was proximal to the small landmark. This suggests that younger children found it somewhat easier to follow directions involving a reference to a containment relation between the small and large landmarks than those involving a proximity relation between the small and large landmarks. Older children's search times for containment and proximity trials were approximately equal, which suggests that they found it equally easy to follow both types of directions. The fact that younger, but not older, children responded differently to the two types of directions is not surprising given that the direction-following task is much easier than the direction-giving task.

Together, the results of Experiments 1 and 2 suggest that young children find containment relations more salient than proximity relations. There is, however, another explanation for the advantage of containment over proximity in these experiments: namely, the distinctiveness of the members of each small landmark pair varied for containment and proximity locations. For containment locations, the target member of the pair was in the large landmark and the nontarget member was on the floor about 5 inches away from the large landmark. For proximity locations, however, the target member of the pair was on the floor next to and touching the large landmark, and the nontarget member was on the floor about 5 inches away from the large landmark. The fact that *both* small landmarks were on the floor for proximity locations but only one of the small landmarks was on the floor for containment locations means that the distinctiveness of the members of each small landmark pair was greater for containment than for proximity locations. As a result, children may have found it easier to distinguish the target from the nontarget small landmark in containment than in proximity trials.

Experiments 3 and 4 tested this alternative explanation in the context of the direction-giving and direction-following tasks used in Experiments 1 and 2. The distinctiveness of the members of the small landmark pairs was equated by using the same pairs of objects for both the containment and the proximity trials. That is, for any given pair, one member was placed *in* the large landmark, and the other member was placed *next to* and touching the large landmark. For containment trials, the small landmark in the large landmark served as the target and the small landmark next to the large landmark served as the nontarget. For proximity trials, the small landmark next to the large landmark served as the target and the small landmark in the large landmark served as the nontarget. Hence, the distinctiveness of the members of the small landmark pairs was equated for both types of trials.

EXPERIMENT 3

Method

Participants

Participants were sixteen 3-year-old and sixteen 4-year-old children from predominantly middle- to upper-middle-class European American families. The mean ages were 3 years, 8 months (*range* = 3,7–3,10) and 4 years, 7 months (*range* = 4,0–4,11). There were eight males and eight females in the 3-year-old group and 10 males and six females in the 4-year-old group. The children were recruited in the same manner as in the previous experiments.

Apparatus and Materials

The dollhouse was the same as that used in Experiment 1. In this experiment, however, the eight small landmarks that served as hiding locations consisted of four rather than eight pairs of identical objects (see Figure 3). Two sets of small landmark pairs were counterbalanced across children to control for any potential effects of specific pairings of small and large landmarks. These sets consisted of the same small landmarks used in the previous experiments. One set included pillows, bags, trashcans, and towels. The other set included boxes, bears, plants, and shoes. Again, four pieces of furniture served as large landmarks: a crib, playpen, basket, and a dresser. Each of the four furniture items served as a large landmark for two identical small landmarks. One member of the identical pair was placed *in* the piece of furniture, and the other was placed *next to* and touching the furniture item. Therefore, all locations involved contact between the small and large landmarks, but four involved the relation of containment and four involved the relation of proximity. This design equated the distinctiveness of both members of each small landmark pair because each member served as the contrasting object for the other member. Again, a Plexiglas cover that could be raised and lowered over the front of the dollhouse was used to prevent children from pointing directly at locations or retrieving the mouse before they described its location. The dollhouse was placed on a low table and the child was always seated directly in front of it. The experimenter sat on the child's left side. Again, the entire session was videotaped with a Panasonic camcorder positioned above the dollhouse.

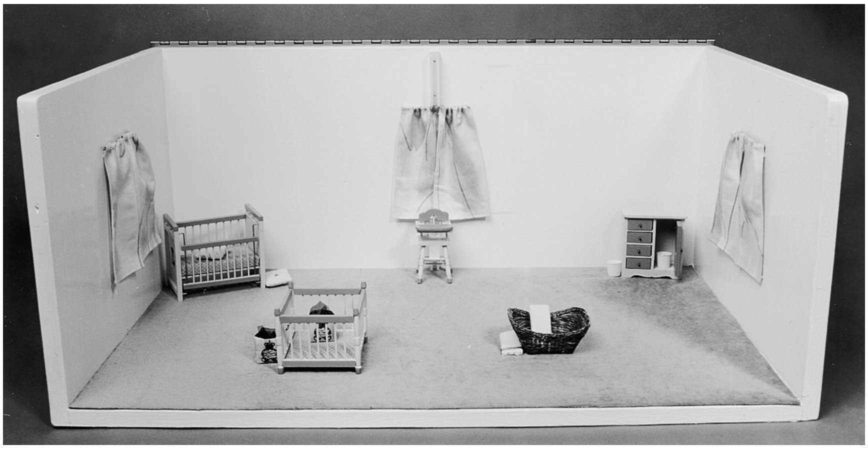

Figure 3 Dollhouse used as experimental space in Experiments 3 and 4.

Design and Procedure

Children again were tested individually in the laboratory. The procedures for the familiarization and test phases of the experiment were the same as that used in Experiment 1. Again, for half of the trials, the mouse was hidden with a small landmark that was *in* a large landmark and for the other half, the mouse was hidden with a small landmark that was *next to* and touching a large landmark.

Coding

All directions again were transcribed verbatim and coded for the targeted information by using the same coding criteria and scores as in Experiment 1. The following aspects of children's communication were coded: (1) small landmark references, (2) large landmark references, (3) containment terms, and (4) proximity terms. As in Experiment 1, only utterances produced spontaneously and in response to the first prompt were coded for the primary analysis. On average, children were prompted on 70% of containment trials and on 84% of proximity trials. An Age (3 versus 4 years) × Spatial Relation (containment versus proximity) repeated measures ANOVA with the first factor as a between-subjects factor and the second as a within-subjects factor revealed a significant effect of spatial relation, $F(1, 30) = 5.61, p < .05$, indicating that children again received significantly more prompts on proximity trials than on containment trials.

Intercoder reliability was calculated on 25% of the sample by using exact percent agreement. Percent agreement for all coding categories (small landmark references, large landmark references, containment terms, and proximity terms) was 100%.

Results

References to the Small Landmark

We first examined whether children again were more likely to refer to the small landmark when the small landmark was *next to* the large landmark than when it was *in* the large landmark. References to the small landmark were entered into an Age (3 versus 4 years) × Spatial Relation (in versus by) repeated measures ANOVA with the first factor as a between-subjects factor and the second as a within-subjects factor. Although references to the small landmark were very high, this analysis yielded a significant main effect of spatial relation, $F(1, 30) = 9.02, p < .01$. As in Experiment 1, children referred to the small landmark more often when it was *next to* the large landmark, $M = 98\%$, $SD = .10$, than when it was *in* the large landmark, $M = 87\%$, $SD = .25$. No other effects were significant.

References to the Large Landmark

We tested whether children referred to the large landmark more often when it contained the small landmark than when it was near the small landmark by entering references to the large landmark into an Age (3 versus 4 years) × Spatial Relation (in versus by) repeated measures ANOVA. As in Experiment 1, there was a significant main effect of spatial relation, $F(1, 30) = 35.07, p < .001$. Children referred to the large landmark 67%, $SD = .30$, of the time when it contained the small landmark, but only 34%, $SD = .40$, of the time when it was near the small landmark. No other effects were significant. Thus, even when the members of the small landmark pairs were equally distinct, children were more likely to refer to the large landmark when it contained the small landmark than when it was near the small landmark.

References to Both the Small and Large Landmarks

The finding that children referred more often to the large landmark when it contained the small landmark than when it was near the small landmark suggests that children find it easier to communicate about containment than about proximity relations; however, given the fact that children showed the opposite pattern for small landmarks, it is possible that they chose to give the small landmark for proximity locations and the large landmark for containment locations. Thus, to test whether children were indeed more likely to successfully disambiguate the pairs of identical small landmarks when the target small landmark was in the large landmark than when it was next to the large landmark, it is important to determine whether spatial relation differences still exist when assessing whether both the small landmark and the large landmark were included in children's descriptions. The mean percentage of references to both the small and large landmarks was entered into an Age (3 versus 4 years) × Spatial Relation (in versus by) repeated measures ANOVA. There was a significant main effect of spatial relation, $F(1, 30) = 15.28$, $p < .001$. Children referred to both landmarks 56%, $SD = .38$, of the time when the small landmark was *in* the large landmark but only 34%, $SD = .40$, of the time when the small landmark was *by* the large landmark.

Use of Spatial Terms

The issue of whether children had more difficulty producing proximity terms than containment terms was addressed by entering containment and proximity term scores into an Age (3 versus 4 years) × Spatial Relation (in versus by) repeated measures ANOVA. (Six children were omitted from this analysis because they provided no large landmarks for any of the containment trials or for any of the proximity trials). This analysis yielded no significant effects. Children produced the correct containment term 93%, ($SD = .21$) of the time and the correct proximity term 91%, ($SD = .28$) of the time. These results suggest that the advantage of containment over proximity was not due to a difficulty with mapping proximity terms onto their correct referents.

Discussion

The results of this experiment show that even when the task was simplified by equating the distinctiveness of the members of each small landmark pair, children still were more successful in disambiguating the identical small landmarks when the target small landmark was *in* rather than *next to* the large landmark. In other words, children were more likely to refer to the large landmark when it contained the small landmark than when it was proximal to the small landmark. This finding strongly supports the idea that containment relations are more salient than proximity relations.

The goal of Experiment 4 was to examine whether there was also an advantage of containment over proximity in the direction-following task when the distinctiveness of the members of the small landmark pairs was equated. In particular, would 3-year-olds still be faster to search for the mouse on containment than on proximity trials when the task was simplified? As in Experiment 3, the same pairs of objects were used for both the containment and the proximity trials. Thus, for any given pair, one member was placed *in* the large landmark and the other member was placed *next to* and touching the large landmark. The direction-following procedure was the same as that used in Experiment 2.

EXPERIMENT 4

Method

Participants

Participants were sixteen 3-year-olds and sixteen 4-year-olds from predominantly middle to upper-middle-class European American families. The mean ages were 3 years, 8 months (*range* = 3,6–3,9) and 4 years, 8 months (*range* = 4,8–4,9). There were equal numbers of males and females in each group. Participants were recruited in the same manner as in the previous experiments.

Apparatus and Materials

The dollhouse and landmarks were the same as those used in Experiment 3. Again, the dollhouse was placed on a low table and the child was always seated directly in front of it. The experimenter sat to the left of the dollhouse. The session was videotaped with a Panasonic camcorder positioned above the dollhouse.

Design and Procedure

Children again were tested individually in the laboratory. The same familiarization procedure was used as in the prior experiments. The direction-following procedure was the same as that used in Experiment 2.

Again, for half of the locations, the experimenter hid the mouse in or under a small landmark that was *in* a large landmark, and for the other half, the experimenter hid the mouse in or under a small landmark that was *next to* a large landmark. The order in which the experimenter hid the mouse at the eight locations was randomized across participants.

Coding

Search accuracy was coded in the same manner as in Experiment 2. Again, children received one score representing the mean percentage of correct searches for containment trials (out of 4) and one score representing the mean percentage of correct searches for proximity trials (out of 4). Intercoder reliability for search errors was calculated on 25% of the sample by using exact percent agreement. Again, agreement was 100%.

Search latencies were also coded in the same manner as in Experiment 2. Ten trials (out of 256 observations) were removed from analysis because the experimenter prompted the child to look for the object after the directions were given. These trials had considerably longer latencies than the other trials, $M = 14.58$. It is important to note that nine (90%) of the prompts occurred on proximity trials. The total number of outliers removed for 3- and 4-year-olds out of 256 observations was 6 and 5, respectively. Again, children received one score representing their mean search latency for containment trials and one score representing their mean search latency for proximity trials. Intercoder reliability was calculated on 25% of the sample by using Pearson correlations. Intercoder reliability was excellent, $r = .99$, with a mean difference between coders of 286 ms.

Results

Search Accuracy

An initial analysis was carried out on children's search accuracy to determine whether children had more difficulty locating the mouse on the first attempt when the small landmark was next to the large landmark than when it was in the large landmark. Mean search accuracy scores were entered into an Age (3 years versus 4 years) × Spatial Relation (in versus by) repeated measures ANOVA with the first factor as a between-subjects factor and the second as a within-subjects factor. This analysis yielded no significant effects. As in Experiment 2, there was no advantage of containment over proximity in the accuracy of children's searches. Children found the mouse on the first try on 90%, ($SD = .15$) of containment trials and on 87%, ($SD = .20$) of proximity trials.

Search Latencies

The primary question of interest was whether 3-year-olds would be faster to search in response to directions involving a containment relation than a proximity relation between the small and large landmark. Mean search latencies were entered into an Age (3 years versus 4 years) × Spatial Relation (in versus by) repeated measures ANOVA with the first factor as a between-subjects factor and the second as a within-subjects factor. This analysis yielded a significant main effect of age, $F(1, 30) = 4.24$, $p < .05$, indicating that 3-year-olds were slower to locate the mouse than were 4-year-olds. Three-year-olds' mean search latency was 2,326 ms, $SD = 712$, and 4-year-olds' mean search latency was 1,920 ms, $SD = 643$. No other effects were significant. The mean search latency was 1,993 ms, $SD = 557$, for containment trials and 2,253 ms, $SD = 813$, for proximity trials. In percentage terms, search latencies for containment trials were only 12% faster than search latencies for proximity trials.

Discussion

The results of this experiment show that when the task was simplified by equating the distinctiveness of the members of each small landmark pair, 3-year-olds no longer searched more quickly in response to directions about containment than about proximity. Across both types of trials, however, 3-year-olds were slower than 4-year-olds to search for the mouse. Again, children of both ages almost always found the mouse on the first try, regardless of trial type. Thus, there was no clear evidence of a bias for containment over proximity in either more gross information-processing measures (i.e., search accuracy) or in more subtle information-processing measures (i.e., search latency).

Clearly, equating the distinctiveness of the members of each small landmark pair greatly simplified the task, even for 3-year-olds. A direct comparison of search latencies in the two experiments supports this conclusion. Mean search latencies were entered into an Age (3 versus 4 years) × Experiment (Experiment 2 versus Experiment 4) × Spatial Relation (in versus by) repeated measures ANOVA. There was a significant main effect of experiment, $F(1, 60) = 22.18$, $p < .001$, which indicates that search latencies were much shorter in Experiment 4, $M = 2{,}123$ ms, $SD = 704$, than in Experiment 2, $M = 3{,}218$ ms, $SD = 1{,}459$. In percentage terms, children were 34% faster to search for the mouse in Experiment 4 than in Experiment 2. The fact that children found the mouse much more quickly in Experiment 4 than in Experiment 2 indicates that the two direction-following tasks differed significantly in difficulty.

GENERAL DISCUSSION

The results of these experiments clearly show that young children find it easier to communicate about containment relations than about proximity relations. When describing the location of a hidden object, 3- and 4-year-olds in Experiment 1 were more likely to disambiguate the target small landmark by including a reference to the large landmark when the large landmark contained the small landmark than when it was near the small landmark. They also remembered the locations of small landmarks more accurately when the small landmark was *in* rather than *next to* a large landmark. Likewise, 3-year-olds in Experiment 2 searched more quickly for a hidden object when the directions included a reference to a small landmark that was *in* rather than *next to* a large landmark. In Experiments 3 and 4, the direction-giving and direction-following tasks were simplified by equating the distinctiveness of the members of each small landmark pair. These experiments revealed that children were still more likely to refer to the large landmark in their directions when it contained the small landmark than when it was near the small landmark. Three-year-olds, however, no longer searched faster for the hidden object when the small landmark was *in* the large landmark than when it was *next to* the large landmark.

Clearly, the task of describing the location of a hidden object elicited a much stronger containment bias than did the task of following directions for finding a hidden object. Why might this be the case? Quite likely, the advantage of containment over proximity depends on the difficulty of the task. In short, young children are less likely to respond differently to obligatory information about containment and proximity when the task is very simple. The fact that children gave unambiguous directions for finding the mouse only about 45% of the time and yet found the mouse on the first try about 90% of the time clearly supports the idea that the direction-giving task was more difficult than the direction-following task. This difference is also consistent with language acquisition studies showing that children can comprehend considerably more words than they can produce (e.g., Benedict, 1979; Huttenlocher, 1974). This suggests that 3- and 4-year-old children should perform quite competently in very simple tasks such as direction-following, regardless of whether the directions involve proximity or containment relations. Likewise, by 5 to 6 years of age, children should be able to unambiguously describe the location of a hidden object in the task, regardless of whether the small landmark is *in* or *next to* the large landmark. Does this mean that the preference for containment or support relations disappears with development? As noted previously, when adults are free to choose which pieces of spatial information to include in their descriptions, they are much more likely to include a small landmark in their spatial descriptions when the target object is *on* rather than *next to* the small landmark (Plumert et al., 1996). This suggests that the preference for communicating information about containment or support over proximity does not disappear with development.

The fact that 3- and 4-year-olds found it easier to give directions about containment than about proximity is consistent with previous research showing that 3- and 4-year-olds also find it easier to give directions about *support* than proximity (Plumert et al., 1995). Thus, it appears that young children are much more likely to disambiguate a target small landmark by referring to another, larger landmark when the large landmark either contains or supports the small landmark than when it is near the small landmark. Together, these findings underscore the idea that both support and containment are more salient than proximity to young children.

The primary question these findings raise is why support and containment are more salient than proximity to young children. There are at least two possible explanations. One is that functional spatial relations are more salient to young children than are nonfunctional spatial relations. As mentioned earlier, both support and containment have important functional consequences for how objects interact with each other. For example, when an object is in a container, the object moves when the container moves. Likewise, objects fall when surfaces of support are removed. When two objects are next to each other, however, the removal of one object usually does not have any consequences for the other object. (One possible exception is the case where one object is leaning against another object. In this case, however, it is not clear whether one would actually use the terms "by" or "next to" to describe the relationship between the two objects.) Repeated experiences with the functional consequences of support and containment relations may serve to highlight such relations between objects for young children. This may also explain why support and containment relations retain a relatively privileged status even after other spatial concepts have been mastered.

Another possible explanation for young children's preferences for support and containment over proximity is that children find it easier to use spatial terms that map onto dichotomous rather than continuous spatial information. The relations "in" and "on" are generally all-or-none in nature; that is, an object can be either on or off or in or out of another object. In contrast, nearness is both continuous and relative. According to Herskovits (1986, p. 16), an object is said to be near another object if the distance between the two is less than or equal to some threshold. This threshold "is an implicit variable whose value is contextually determined." This general lack of specificity about nearness in linguistic and conceptual representations may influence young children's communication about location. That is, they may have more difficulty describing proximity relations because it is not clear how close two objects must be to be classified as near one another. Clearly, further research is needed to reach a better understanding of how conceptual and linguistic factors operate in biases in young children's spatial communication.

Although young children seem to prefer support and containment over proximity, there may be some important differences between support and containment relations. The present investigation revealed that children in both direction-giving experiments were less likely to refer to the *small landmark* when it was in than when it was next to the large landmark. In other words, for containment trials, children occasionally initially bypassed the relation between the mouse and the small landmark (e.g., "The mouse is in the *box*") and instead referred to the relation between the mouse and the large landmark (e.g., "The mouse is in the *crib*"). For proximity trials, children virtually always referred to the relation between the mouse and the small landmark. Plumert et al. (1995), however, did not find this difference in references to the small landmark when comparing support and proximity. That is, children's references to the small landmark did not depend on whether the small landmark was *on* or *next to* the large landmark. The implication of these findings is that young children may perceive containment relations as more salient than support relations. Thus, although children usually initially choose to describe the location of the mouse in relation to the small landmark, they are more likely to bypass the relation between the mouse and the small landmark when the small landmark is *in* rather than *on* the large landmark.

This finding is consistent with research on young children's acquisition of spatial prepositions (Clark, 1973, 1980; Dromi, 1979; Johnston & Slobin, 1979). Specifically, research has shown that children from a variety of cultures generally acquire spatial terms in the following order: *in*, *on*, *under*, and then *next to* or *by* (Dromi, 1979; Johnston & Slobin, 1979). Clark has also shown that very young children's understanding of the meanings of spatial terms is biased more strongly toward containment than support relations. When presented with a reference object and given instructions for placing a toy *in*, *on*, or *under* the reference object, children under the age of 2 responded according to the following rule: "If the reference object is a container, put the toy *inside* of it." Children under the age of 2, therefore, make a large number of errors, most of which can be attributed to this rule. The second rule young children appeared to follow was "If the reference object has a horizontal surface, put the toy *on* it." These rules accounted for most of the errors committed by children under the age of 3. The fact that young children's initial biases about the meanings of spatial terms are biased more toward containment than support suggests that containment relations may be more salient than support relations. Moreover, the results of the present investigation suggest that the preference for containment over support does not disappear after children learn the meanings of containment and support terms.

Finally, the present investigation revealed few developmental differences in 3- and 4-year-olds' ability to give directions that included more than one landmark. That is, there were no developmental differences in young children's references to the large landmark in either of the direction-giving experiments. This is inconsistent with previous work showing that 3-year-olds are less likely to disambiguate a target small landmark by referring to a large landmark (Plumert et al., 1995). One possible reason for this difference between the two investigations is that younger children may have found it somewhat easier to communicate about the relation between a small and large landmark when the large landmark contained the small landmark than when it supported the small landmark. An informal comparison between the two studies supports this conclusion. In Plumert et al. (1995), 3-year-olds referred to the supporting large landmark in 39% of their descriptions, whereas in the present investigation, they referred to the containing large landmark in approximately 59% of their descriptions. The difference between 4-year-olds' performance in the two studies was almost negligible. These findings offer further support for the idea that young children perceive containment relations as more salient than proximity relations. However, because we have not directly compared children's abilities to communicate about containment and support, further research is needed to determine if this hypothesis is in fact correct.

One general issue these findings raise is whether biases in how children communicate about location can inform us about biases in how they think about location. For example, are children better at remembering where something is hidden if the target object is *in* or *on* a landmark than if the target object is *next to* a landmark? Assessments of location memory in the present investigation and in Plumert et al. (1995) suggest that this might be the case. In both investigations, 3- and 4-year-olds were more likely to correctly replace small landmarks when the landmarks were in or on large landmarks than when they were next to large landmarks. Thus, it appears that young children's ability to code location is also influenced by the nature of the spatial relation between landmarks. Likewise, Bushnell, McKenzie, Lawrence, and Connell (1995) found that 12-month-old infants could use landmarks to remember the location of an object, as long as the landmark was coincident with the location of the target (i.e., under), but not if the landmark was noncoincident (i.e., next to the target). In fact, remembering the target in relation to a noncoincident landmark was more difficult for 12-month-olds than when no landmark was present, and infants could rely on dead reckoning to locate the object. Together, these findings suggest that biases in young children's communication about location may be related to more general biases in how they remember location. Further investigations of biases in children's ability to remember and communicate about location may provide insight into the relations between spatial cognition and spatial language.

ACKNOWLEDGMENTS

This work was supported in part by the Obermann Center for Advanced Studies at the University of Iowa. The authors would like to thank Beth Collison, Stephanie Dawes, Penney Nichols-Whitehead, Eda Pinar, and Jennifer Rothman for their help with data collection and coding.

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