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# The Content and Organization of Communication about Object Locations

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Four experiments investigated how the communication task and the structure of the environment influence the content and organization of messages about object locations. Subjects placed objects in a multi-level space and later wrote down messages about the object locations. In Experiments 1 and 2, subjects treated the tasks of *giving directions about how to find the objects* and *describing where the objects were* differently. Hierarchically organized *directions* usually started with the most general spatial unit, but *descriptions* usually started with the most specific spatial unit. Experiments 3 and 4 examined how the spatial relation between the object and the small and large landmarks influenced the order in which landmarks were mentioned. Subjects almost always mentioned large landmarks before small landmarks when the object was *on* the large landmark and *next to* the small landmark. In contrast, subjects mentioned large landmarks before small landmarks only about half of the time when the object was *on* the large landmark and *in*, *on*, or *underneath* the small landmark. Together, the communication task and the organization of landmarks determined the extent to which spatial messages were hierarchically organized. Findings are discussed in terms of what they tell us about the pragmatics of spatial communication and conceptual biases in coding object locations. 

Most of what we currently know about how people verbally represent object locations concerns the syntactic and semantic rules governing use of spatial prepositions (Cienki, 1989; Herskovits, 1986; Landau & Jackendoff, 1993; Miller & Johnson-Laird, 1976; Talmy, 1983). This level of analysis almost always focuses on the spatial relation between an object and a single landmark or spatial region (e.g., "the pencil is on the desk"). In many situations, however, referencing an object in relation to a single landmark or spatial region is insufficient to specify its location precisely. Imagine, for example, that you are staying at the home of someone else and find yourself in need of a safety pin. Given that you know relatively little about the house, either of the following responses to a query about where the safety pins are would not be very helpful: (a) "the safety pins are upstairs," or (b) "the safety pins are in a little red box." Obviously, the first description is too general and the second is too specific. A more useful response might be, "the safety pins are in a little red box in the medicine cabinet in the bathroom upstairs." In short, effective spatial messages often involve communicating the spatial relations among several regions and landmarks. The present investigation examined how speakers actually go about selecting and organizing spatial information in messages about individual object locations. Our aim was to determine how the goals of the communication task and the structure of the environment might influence the content and orga-

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nization of messages about object locations.

The example given above suggests that useful messages about object locations usually include spatial units of varying levels of inclusiveness.[1] Thus, when describing the location of an object in a multi-level building, one would probably include a reference to the floor, the room, and a large and small landmark within the room. Why might speakers do this? Quite simply, failure to include spatial units of varying levels of inclusiveness creates a needle in a haystack problem for the listener. As Miller and Johnson-Laird (1976) point out, it would be very odd to say that "the ashtray is near the town hall." Likewise, it would not be very useful only to inform a listener that "the safety pins are in the bathroom which is next to the bedroom and directly above the kitchen." Searching the area near the town hall for an object the size of an ashtray could take days or weeks. Furthermore, there is a high probability that the search would be unsuccessful. Likewise, knowing the spatial relations among regions at the same level of generality (e.g., bathroom, bedroom, and kitchen) does not help the listener pinpoint the location of the safety pins. This suggests that one rule of spatial communication might be to provide information that will sufficiently narrow the search space for the listener.

Crafting effective messages requires more than just including several units of spatial information at varying levels of generality. Speakers must also organize those spatial units in a way that can be easily understood by the listener. What sorts of organizations might be useful? One likely candidate is to order spatial information according to a hierarchy of inclusiveness of spatial region (e.g., "the keys are in my *purse* on the *desk* by the *windows* in the *TV room* in the *basement*"). Hierarchical organization helps the listener because it lessens referential ambiguity among spatial units and reduces the need for potentially effortful restructuring of spatial information. For example, the previous message about where the keys are is much clearer than "the keys are in the basement in my purse in the TV room by the windows on the desk." In order to make sense out of the latter statement, the listener must realize that the purse, not the TV room or the windows, is on the desk. Plumert and Carswell (1992), in fact, found that people comprehend hierarchically organized descriptions faster than nonhierarchically organized descriptions.

Most of the research to date on hierarchical organization in spatial communication has focused on the order in which people describe a collection of objects or rooms from a spatial layout (Plumert, Pick, Marks, Kintsch, & Wegesin, 1994; Shanon, 1984; Taylor & Tversky, 1992; Ullmer-Ehrich, 1982). Taylor and Tversky (1992), for example, found that the order in which adults drew and described landmarks learned from maps reflected hierarchical structuring of information. Similarly, Shanon (1984) found that people tended to describe their dormitory room by referring first to the larger, more stable elements of the room and then to the smaller, moveable things in the room. Although very little research exists about descriptions of individual object locations, Plumert et al. (1994) found that both adults and children as young as six years directed others to object locations in their homes by first orienting the listener to the larger region containing the object and then describing increasingly smaller areas and landmarks near the target object.

Another possible way of organizing spatial messages is to give information about where the room is and then about where the object is within the room ("the keys are in

[1] The arguments that follow about the content and organization of spatial messages apply to speakers communicating with naive listeners. When a listener knows a great deal about a space, speakers may omit pieces of information that they would be likely to include when the listener is unfamiliar with a space. These issues are discussed in more detail in the General Discussion.

the *basement* in the *TV room* in my *purse* on the *desk* by the *windows*''). Such ''quasi-hierarchical'' messages help the listener because they chunk spatial information into two parts: (1) where the room is and (2) where the object is within the room.[2] This type of organization is consistent with recent findings showing that people directly code both the relation between the object and the room and the object and the landmark (Carswell & Plumert, 1993). That is, people are equally fast to verify that the ''keys are in the TV room'' as the ''keys are in the purse,'' but are slower to verify that the ''keys are in the basement.'' This suggests that the relation between the object and the room and the relation between the object and the landmark with which it is located are key components of spatial messages.

Given that these two kinds of organizational structures are useful for structuring messages about object locations, what factors determine whether people tend to rely on one or the other organization? In this paper, we argue that the communication task and the organization of landmarks within the environment jointly constrain the global structure of spatial messages. We first discuss how these two factors influence local organizational properties of messages and then we discuss how these local organizational properties influence the global structure of messages.

Although spatial communication tasks differ in a number of ways, one important distinction seems to be whether the task involves giving directions for *how to find something* or providing a description of *where something is*. When the task is to tell someone how to find something, the goal is to get the listener from his/her present position to the location of the object. As a result, the direction-giver is likely to focus on providing the spatial information in the correct temporal sequence (i.e., ordering units of spatial information from large to small). That is, the listener must reach the floor before the room, and once inside the room, is likely to notice large landmarks before small landmarks. Plumert et al. (1994), in fact, found that directions for finding missing objects usually were structured in a descending fashion (e.g., ''look in the basement in the laundry room on the washing machine in a measuring cup'').

When the task is to describe to someone where an object is located, the goal may be to recall information about the location, but not necessarily to tell the listener exactly how to go about finding the object. Without the constraint of directing the listener's movements through the space, speakers may find it easier to start their description at the landmark with which the object is located. That is, speakers may first focus on the immediate landmark with which the object is located and then try to provide information about where that landmark is in relation to other larger landmarks and where the larger landmarks are in relation to the room and so on. Thus, descriptions of object locations may be more likely to start with the most specific spatial unit and work toward the most general spatial unit.

A second factor that may influence the organizational properties of spatial messages is the structure of the environment. Taylor and Tversky (1993), for example, found that environmental features influenced whether descriptions of layouts were conveyed in a survey or route form. One aspect of the physical environment that may play a role in communication about object locations is the spatial relations that exist between objects and landmarks in the environment. Miller and Johnson-Laird (1976) speculated that people are more likely to choose salient landmarks over other landmarks in their communication about object locations. We suggest that saliency also may influence the *ordering* of landmarks in spatial messages.

[2] In this paper we designate such messages as quasi-hierarchical because the term seems to capture the notion that subsets of spatial units are hierarchically organized, but that the message as a whole does not follow a strict hierarchical order.

What makes a landmark salient? Although others have suggested that features such as size, color, and familiarity make landmarks salient (e.g., Miller & Johnson-Laird, 1976), we argue that the *spatial relation* that exists between an object and a landmark also determines saliency. In particular, landmarks that perform functions of supporting, containing, or covering objects may be perceived as more salient than landmarks that are next to objects. Support for this position thus far comes from the finding that young children learn terms for support (i.e., "on") and containment (i.e., "in") before they learn terms for proximity (i.e., "next to" or "by") (Clark, 1973, 1980; Johnston & Slobin, 1979), and that even when young children know proximity terms they are more likely to remember and communicate about support than proximity relations (Plumert, Ewert, & Spear, in press). For example, young children are more likely to communicate to a listener that "the bear is in the box *on* the table" than "the bear is in the box *by* the table" even though the term "by" is in their lexical repertoire.

Why might such biases in coding location exist? In other words, why might children and adults find landmarks that support and contain objects as more salient than those that are proximal to objects? First, when a landmark supports or contains an object, there is a physical, functional connection between the two that is not present when an object is proximal to a landmark. Although the terms "in" and "on" have extensive uses, one object is said to be *on* another object when the second object offers a surface of support for the first object. Likewise, one object is said to be *in* another object when the second object acts as a container enclosing the first object (Cienki, 1989; Herskovits, 1986; Miller & Johnson-Laird, 1976). When such relations exist between objects, these objects interact with one another in special ways that may further strengthen the connection between them. Most notably, when a surface of support is removed, objects fall, and when a container is moved, the objects inside it move also. In contrast, although two objects that are next to one another can have a thematic relation (e.g., a spoon next to a bowl), a physical, functional relation does not exist between the two.

Another reason why spatial relations of *in, on,* and *underneath* may be perceived as more salient than *next to* concerns the specificity of each relation. That is, *in, on,* and *underneath* seem to map onto dichotomous physical dimensions whereas *next to* seems to map onto a continous physical dimension (i.e., distance). 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. The term "underneath" is less clear-cut but also seems to be a dichotomous spatial relation. That is, one object is said to be *underneath* another object when the first object is in contact with the bottom surface of the second object and the two objects are vertically aligned (Talmy, 1983). In contrast, nearness is both continuous and relative. According to Herskovits (1986), 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" (p. 16). Although some languages (e.g., Korean) make further distance distinctions such as "not near but within reach" and "not near but visible," most languages do not code distance at many levels of detail (Landau and Jackendoff, 1993). This general lack of specificity about nearness in linguistic and conceptual representations may influence speakers' coding of object location. That is, they may avoid using proximity to code object locations because it is not clear how close two objects must be in order to be classified as near one another.

How might these hypothesized biases contribute to the order in which landmarks are mentioned? Consider the arrangements of objects diagrammed in Fig. 1. In both

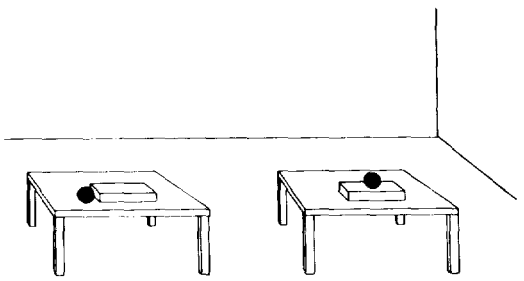

FIG. 1. Schematic diagram of supporting and proximal small and large landmarks.

situations, the ball and the box are *on* the table (for a discussion of the transitivity of support relations, see Herskovits, 1986; Miller & Johnson-Laird, 1976). In the arrangement on the left side of Fig. 1, the ball is *next to* the box and in the arrangement on the right, the ball is *on* the box. If people perceive supporting landmarks as more salient than proximal landmarks, then they should always refer to the table before the box in situations like those depicted on the left side of Fig. 1 (i.e., "the ball is *on* the table *next to* the box"). When the ball is *on* the box and *on* the table, however, the two landmarks may compete with one another because they are equally salient. Hence, people should refer to the table before the box only about half of the time in situations like those depicted on the right side of Fig. 1 (i.e., "the ball is *on* the table *on* the box").

How do the communication task and the organization of landmarks within the environment give rise to the global structure of spatial messages about object locations? When giving directions for finding objects, speakers may prefer to start out with the floor and the room. As outlined above, the order in which nested landmarks are mentioned may be influenced by the perceived salience of the spatial relations that connect the referent object to the landmarks. If the objects are *on* the large landmarks and *next to* the small landmarks, the large landmark usually should be mentioned first. This would result in mostly hierarchically organized messages. If the objects are *on* the large landmarks and *on* the small landmarks, the large landmark should be mentioned first only about half of the time. This should result in approximately half hierarchical directions and half quasi-hierarchical directions.

We investigated how the communication task and the organization of landmarks within the environment influence the content and organization of messages about object locations in a series of experiments. The first two experiments concerned how the nature of the communication task influences the organizational properties of spatial messages. In Experiments 1 and 2, subjects placed a set of objects in a multi-level space and later either wrote down *directions* for finding the objects or wrote down *descriptions* of the object locations. We assessed two aspects of organization in subjects' messages: 1) whether units of spatial information were hierarchically or quasi-hierarchically organized, and 2) whether units of spatial information were conveyed in an ascending or in a descending order. The second two experiments concerned how the organization of landmarks within the environment influences the content and organization of spatial messages. In Experiments 3 and 4, subjects hid several objects in a multilevel space and later wrote down directions for finding those objects. In both experiments, we manipulated the spatial relations between the target objects and available large and small landmarks. Of particular interest was whether the spatial relations present influenced the order in which subjects referred to nested landmarks and hence the global structure of the directions.

## EXPERIMENT 1

### *Method*

#### *Subjects*

Twenty-four female undergraduates served as subjects. All subjects were members of a sorority at the University of Iowa and had lived in the sorority or visited it weekly for at least 6 months.

*Design and Procedure*

Each subject was tested individually at the sorority house. Subjects first were taken to the testing room on the third floor and instructed that they would be placing 24 objects in different places around the house and that they should try to remember as much as possible about where each object was placed. The experimenter then gave the subject the first object to place, led her to the location and said, "put the ___ right here." Immediately after each object was placed, the experimenter retrieved another object from the bag she was carrying, handed it to the subject, and led her to the next location.

All subjects placed the same 24 objects in the same locations. Two locations in each of twelve rooms on the bottom two floors of the house were used. In order to maximize recall, objects were chosen that were meaningfully linked to the room in which they were hidden. For example, a salt shaker was hidden in the kitchenette, a remote control was hidden in the TV room, and a greeting card was hidden in the mailbox room. The order in which the objects were placed was randomized across subjects with the constraint that the two objects in each room were never placed one after the other. As a result, subjects followed a random route throughout the house that took them up and down the two stairways several times. After placing all of the objects, subjects returned to the testing room where they performed a spatial communication task.

Subjects were randomly assigned to two groups. In the *direction-giving* condition, the experimenter informed subjects that "I'm going to hand you several sheets of paper one at a time with the names of the objects written on them. When you get each one, I want you to write down directions for finding the object named on the piece of paper." In this condition, subjects received pieces of paper with the sentence, "To find the (object name) . . ." printed at the top. They were told that we were collecting written directions so later we could see if someone who had only visited the house once or twice could find the objects using their directions. In addition, subjects were instructed to use the doorway to the stairway near the testing room as the starting point for each set of directions. In the *description* condition, the experimenter informed the subjects that "I'm going to hand you several sheets of paper one at a time with the names of the objects written on them. When you get each one, I want you to write down as much information about the location of each object as you can remember." They were then handed pieces of paper one at a time with the sentence "The (object name) is . . ." printed at the top. The order in which the experimenter presented the forms was randomized across subjects. The experimenter collected each form immediately after subjects finished writing their message.

*Coding*

*Errors.* A message was coded as incorrect when subjects gave false information or no information about an object location. All incorrect messages were excluded from the analyses. The mean number of correct messages given by the description and direction-giving groups was 21.8 and 22.6 out of 24, respectively, $F(1,22) = 1.05$, n.s.

*Units of spatial information.* Seven types of spatial units were coded in subjects' messages. These units corresponded to seven nested levels of spatial information: (1) floor, (2) floor part, (3) room, (4) room part, (5) large landmark, (6) large landmark part, and (7) small landmark. A reference to a *floor* was coded as present when subjects made statements such as "go downstairs" or "it's on the floor where we eat." A reference to a *floor part* was coded as present when subjects made statements such as, "go toward the east side of the basement" or "it's in the front part of the first floor." A reference to a *room* was coded as present when subjects named the room, mentioned

its function, or described its appearance. For example, a subject might refer to a room by saying "look in the place where the bikes are" or "it's in the bike room." A *room part* was coded as present when subjects made statements such as "look in the corner" or "it's in the right hand side of the living room." A *large landmark* was coded as present when subjects mentioned an appliance, piece of furniture, or other stable large object such as a radiator or fireplace. A reference to a *large landmark part* was coded as present when subjects made statements about distinct parts of large landmarks such as "look on the right hand side of the couch" or "it's on the left front corner of the table." A *small landmark* was coded as present when subjects mentioned small moveable objects such as baskets, pillows, bags, or bowls. References to objects in which a larger object was used to modify a smaller target part were coded as single small landmarks. For example, the "washing machine lint catcher" and "the lint catcher of the washing machine" were considered to be single landmarks.

*Organization of spatial units.* Two aspects of organization were coded. The first concerned how units of spatial information were organized relative to one another. Messages were classified as either hierarchical, quasi-hierarchical, or unorganized. Because a minimum of three spatial units is necessary to determine whether a description is hierarchically or quasi-hierarchically structured, only descriptions containing three or more spatial units were included in the analyses of organizational structure. On average, 68% of messages in the description group and 99.6% of messages in the direction-giving group contained three or more spatial units.

A message was coded as *hierarchical* when the spatial units included in the message were conveyed either in a descending order (i.e., largest to smallest spatial unit), or in an ascending order (smallest to largest spatial unit). For example, a subject might write, "the salt shaker is in the popcorn bowl on top of the fridge in the kitchenette" or "the salt shaker is in the kitchenette on top of the fridge in the popcorn bowl." A message was coded as *quasi-hierarchical* when first the floor and then the room (or just the room if the floor was omitted) were mentioned, followed immediately by the smallest landmark and then by progressively larger landmarks (e.g., "the book of matches is in the living room, underneath the log in the log bin, to the right of the fireplace" or "to find the magazine, go down the stairs, through the living room and into the solarium. It's behind a lamp on the furnace against the east wall"). A description was coded as *unorganized* if it did not conform to either a hierarchical or quasi-hierarchical organization.

The second aspect of organization concerned whether levels of spatial information in hierarchical messages were conveyed from general to specific, or from specific to general. We addressed this issue by classifying hierarchical messages as either ascending or descending. Messages were coded as ascending when the units of spatial information were conveyed in an order of increasing size, and descending when the units of spatial information were conveyed in an order of decreasing size.

*Reliability.* Two coders scored four randomly selected subjects' protocols so that reliability could be assessed. With the exception of number of spatial units present, reliability was calculated using exact percent agreement. Intercoder agreement for organizational structure and ascending vs. descending organization was 85 and 100%, respectively. Intercoder agreement for the number of spatial units present was $r = .96$.

## Results

### Elaborateness of Messages

We addressed the issue of whether the communication task affects the amount of detail in spatial messages by comparing the mean number of spatial units each communication group included in their messages.

Subjects in the *direction-giving* group ($M$ = 5.9) included significantly more spatial units in their messages than did subjects in the *description* group ($M$ = 2.9), $F(1,22)$ = 84.91, $p < .001$. Thus, the task of writing down directions about how to find objects elicited much more detailed messages than did the task of writing down descriptions of object locations.

*Organization of Messages*

Examples of hierarchical, quasi-hierarchical, and unorganized messages from the *description* and *direction-giving* groups are shown in Table 1. The majority of messages produced by subjects were either hierarchical or quasi-hierarchical. In the *description* and *direction-giving* groups, organized messages constituted 75 and 67% of messages with three or more spatial units, respectively.[3] To compare whether subjects in the two groups differed with respect to their use of the two organizational schemes, scores for the proportion of hierarchical messages were calculated by dividing the number of hierarchical messages by the total number of organized messages (i.e., hierarchical and quasi-hierarchical messages). The *direction-giving* group ($M$ = .86) gave a higher proportion of hierarchical messages than did the *description* group ($M$ = .71), $F(1,22) = 5.47$, $p < .05$.

We also examined the extent to which subjects in the two communication groups organized their hierarchical messages in an ascending (i.e., small to large) or in a descending fashion (i.e., large to small). Scores for the proportion of descending hierarchical messages were calculated by dividing the number of descending messages by the total number of hierarchical messages. Descending organization occurred in 1.00 of hierarchical messages produced by subjects in the *direction-giving* group and in .65 of those produced by the *description* group, $F(1,22) = 12.43$, $p < .01$. We also compared the proportion of descending directions to chance performance ($p$ = .50)

TABLE 1
EXAMPLES OF HIERARCHICAL, QUASI-HIERARCHICAL, AND UNORGANIZED MESSAGES

| |
|---|
| Hierarchical messages |
| Description group |
| The remote control is . . . in the yellow box on the shelf by the TV in the TV room. |
| Direction-giving group |
| To find the book . . . go down the first set of stairs, go right into the living room. Go over to the bookcase. It is on the left hand side, on the bottom shelf behind a Sig Ep plaque. |
| Quasi-hierarchical messages |
| Description group |
| The remote control is . . . in the TV room in a yellow papered box, along the shelf near the TV. |
| Direction-giving group |
| To find the book . . . go down the stairs. Turn right at the bottom and go into the library. It's behind a plaque on the bottom shelf on the left-hand side on shelves at the end of the room. |
| Unorganized messages |
| Description group |
| The greeting card is . . . in the mailboxes "room" on radiator shelf below the mailboxes, underneath a basket of rubber bands on the right side of the shelf. |
| Direction-giving group |
| To find the potato chip bag . . . go down both flights of stairs, take a right into the TV room. Go right to the back corner. It is in a box on the floor behind the door under a newspaper. |

[3] We used the binomial formula to determine whether *individual* subjects were using the two schemes more than that expected by chance. For each subject, the number of hierarchical messages and the number of quasi-hierarchical messages containing a given number of spatial units was compared to chance. For example, if a subject produced 13 messages with 3 spatial units, the probability that 6 or more of those would be quasi-hierarchical is .01 ($p$ = .17, $q$ = .83). If the same subject produced 7 messages with 4 spatial units, the probability that 3 or more of those messages would be hierarchical is .02 ($p$ = .08, $q$ = .92). Therefore, this subject would be classified as demonstrating above chance use of both hierarchical and quasi-hierarchical organization. (It is important to note that it was impossible to compute probabilities on subjects as a group because almost all subjects produced messages with varying numbers of spatial units). Across the four experiments, the mean proportion of subjects in each condition exhibiting significantly above chance use of hierarchical and quasi-hierarchical organization was .58 (range = 1.00 to .36) and .52 (range = .86 to .14), respectively.

using one-sample $t$ tests. (Analyses of chance performance were carried out only on messages produced by the description group because all hierarchical messages given by the direction-giving group were descending). The proportion of descending hierarchical messages given by the description group did not differ from chance, $t(11) = 1.49$, n.s. Together, these findings suggest that the task of giving *directions* about how to find something pushed subjects to structure spatial information in the order in which their listener would encounter the information. When asked simply to *describe* where something was, however, subjects may have been less constrained by the communicative demands of the task and hence were more likely to convey spatial information in either direction.

### *Discussion*

The results of this experiment suggest that hierarchical organization plays an important role in communication about object locations. Although subjects in the *direction-giving* group provided more hierarchical messages than did subjects in the *description* group, it appears that both communication groups exhibited a preference for hierarchical over quasi-hierarchical organization. The results of this experiment also suggest that the communication task plays an important role in how spatial hierarchies are verbally represented. That is, subjects were more likely to order spatial units from large to small when the task was to write down directions for finding the objects than when the task was to write descriptions of object locations.

The present experiment provided a test of how the communication task influences the content and organization of messages about object locations in large-scale, familiar spaces. A note of caution is warranted, however, about potential limitations of this study that may have influenced some of the results. First, subjects in the direction-giving condition were instructed to use the testing room as a starting point for their directions. Therefore, in order to direct a listener to any of the objects from the testing room, subjects first had to make a reference to going downstairs. This may have increased the occurrence of descending organization in their directions. Second, subjects in the direction-giving condition were instructed to write directions that would help someone who was unfamiliar with the house find the objects, whereas subjects in the description condition were instructed to write down as much as they could remember about the object locations. Subjects in the direction-giving condition may have included more detail in their directions because they thought that they were writing down directions for an actual listener.

A second, laboratory-based experiment was carried out to clarify the influence of the communication task on messages about object locations. In the second experiment, subjects placed objects in a multi-level model house and later either wrote down directions for finding those objects or descriptions of the object locations. On the basis of other research using maps and narrative descriptions of spaces (e.g., Bryant, Tversky, & Franklin, 1992; Taylor & Tversky, 1992), we expected that subjects would have no trouble using the model as a representation of a real space. We made two procedural changes to address the concerns outlined above. First, subjects in the direction-giving condition were not given a starting point for their directions, and second, subjects in both the direction-giving and description conditions were instructed to write messages that would help someone else locate the objects.

## EXPERIMENT 2

### *Method*

#### *Subjects*

Thirty-two undergraduates served as subjects in return for course credit in their elementary psychology course. There were equal numbers of males and females in each condition.

*Apparatus and Materials*

A 30 cm deep × 114 cm wide × 94 cm high model house was used as the experimental space. Each of the three floors was subdivided into four rooms. Each room contained several large landmarks (e.g., bed, chair, table, and workbench) and several small landmarks (e.g., hat, cookbook, plant, basket, and helmet). There was one placement location in each room resulting in a total of 12 locations. Twelve unrelated objects were placed at the 12 locations. For each location, the target object was placed either *in* or *under* a small landmark that was either *on* or *next to* a furniture item. The pairings of objects and locations were randomized across subjects.

*Design and Procedure*

The session began with a familiarization period in which individual subjects were shown the model house. The experimenter informed subjects that they would be asked to place several objects in the model house and later recall the locations of those objects. The experimenter named the floors and rooms in the house in a random order and then left the room for three minutes while subjects studied the model house. When the experimenter returned, he/she reviewed the floors and rooms by pointing to the floors and rooms in a random order and asking subjects to name them. Corrections were made as necessary.

The second part of the session involved placing the objects in the model house. For each location, the experimenter handed subjects an object, pointed to the location, and said, "put the_____ right here." Subjects were instructed to hide the objects out of sight. The order in which the objects were placed was randomized across subjects. After all 12 objects were placed, the experimenter randomly named each object and asked subjects to point to their locations. If subjects pointed to the wrong location or could not remember a location, the experimenter pointed to the correct location. This procedure was repeated until subjects completed two successive errorless trials. Subjects rarely made any errors after the first correct trial. The mean number of placement trials was 3.5 with a range from 2 to 8.

During the third part of the session, subjects performed a spatial communication task. The experimenter first covered the model house and then seated subjects at a table facing away from the house. Subjects were randomly assigned to the *direction-giving* condition or the *description* condition. As in Experiment 1, the experimenter informed subjects in the direction-giving condition that "I'm going to hand you several sheets of paper one at a time with the names of the objects written on them. When you get each one, I want you to write down directions of *how to find each of those objects* so that someone else would know how to look for them on the basis of your directions." They were then handed the pieces of paper one at a time with the sentence "To find the (object name) . . ." printed at the top. Likewise, the experimenter informed subjects in the description condition that "I'm going to hand you several sheets of paper one at a time with the names of the objects written on them. When you get each one, I want you to write down descriptions of *where each of those objects is located* so that someone else could locate the objects on the basis of your descriptions." They were then handed the pieces of paper one at a time with the sentence "The (object name) is . . ." printed at the top. The order in which subjects received the object names was randomized across subjects. The experimenter collected each piece of paper immediately after subjects finished writing their message.

*Coding*

As in the previous experiment, all incorrect messages were excluded from the analyses. The mean number of correct messages given by the description and direction-giving groups was 11.6 and 11.2 out of

12, respectively, $F(1,30) = 1.51$, n.s. The same coding system was used as in Experiment 1 to classify each type of spatial unit. As in Experiment 1, messages containing three or more spatial units were classified as either hierarchical, quasi-hierarchical, or non-hierarchical. On average, 89% of messages in the description group and 92% of messages in the direction-giving group contained three or more spatial units. Hierarchical messages also were classified as either ascending or descending. Two coders scored four randomly selected subjects' protocols for reliability purposes. Intercoder agreement for organizational structure and ascending vs descending organization was 98 and 100%, respectively. Intercoder agreement for the number of spatial units present was $r = .90$.

### *Results*

#### *Elaborateness of Messages*

As in Experiment 1, subjects in the *direction-giving* group included significantly more spatial units in their messages ($M = 3.90$) than did subjects in the *description* group ($M = 3.40$), $F(1,30) = 4.22$, $p < .05$.

#### *Organization of Messages*

Again, the majority of messages produced by subjects were either hierarchical or quasi-hierarchical. In the *description* and *direction-giving* groups, organized messages constituted 75 and 70% of messages with three or more spatial units, respectively. The *description* group ($M = .64$) produced a higher proportion of hierarchical messages than did the *direction-giving* group ($M = .38$), $F(1,30) = 5.00$, $p < .05$. Surprisingly, this pattern was exactly opposite to that found in Experiment 1.

As in Experiment 1, we compared the proportion of descending hierarchical messages provided by subjects in the two communication groups. Four subjects were excluded from this analysis because they did not provide any hierarchical messages. (One subject was from the description group and the other three were from the direction-giving group). A greater proportion of hierarchical *directions* ($M = .76$) than *descriptions* ($M = .24$) were descending, $F(1,26) = 12.63$, $p < .01$. Analyses of chance performance ($p = .50$) revealed that the proportion of descending *directions* was significantly above chance, $t(12) = 2.39$, $p < .05$, and that the proportion of descending *descriptions* was significantly below chance, $t(14) = 2.65$, $p < .05$. In other words, hierarchical *directions* for finding the objects usually started with the most general spatial unit and worked forward to the most specific unit, whereas hierarchical *descriptions* of the object locations usually started with the most specific unit and worked backward to the most general unit.

### *Discussion*

The comparisons of ascending versus descending organization in hierarchical messages provide further evidence that the communication task plays an important role in verbal representation of spatial information. When describing how to find something, speakers first orient listeners to the most general spatial unit and then work toward the most specific spatial unit. When describing where something is, however, speakers first focus on the most specific spatial unit and then work backward to the most general spatial unit. Unlike Experiment 1, however, subjects who wrote down directions for finding the objects produced fewer hierarchical messages than did subjects who wrote down descriptions of the object locations. In fact, the patterns of organization for the two groups were exactly opposite. Almost two-thirds of the organized messages produced by the direction-giving group were quasi-hierarchical, whereas two-thirds of the organized messages produced by the description group were hierarchical.

What might account for the difference between the two experiments? One possibility is that people respond differently to large- and small-scale spaces. That is, because there are stronger constraints on the

listener's movement when searching for objects in a large-scale space than in a small-scale space, the speaker may feel more compelled to mention units of spatial information in the order in which the listener will encounter them in large-scale spaces. It is unclear, however, why scale would affect giving directions for finding objects but not descriptions of object locations. That is, subjects who wrote down descriptions of locations in the two experiments produced almost equal proportions of hierarchically organized messages. In contrast, there was a 50% drop in the proportion of hierarchical directions from Experiment 1 to Experiment 2.

A more likely explanation for the difference between experiments concerns how the communication task interacts with the organization of the landmarks in the environment. When giving directions for finding objects, speakers show a clear preference for starting out with the floor and the room. At this point, the speaker must decide the order in which to refer to landmarks within the room. If the speaker starts with the large landmarks and works progressively toward the small landmarks, the direction becomes hierarchical. On the other hand, if the speaker goes directly to the small landmark and works progressively backward to the larger landmarks, the direction becomes quasi-hierarchical.

What might influence the ordering of landmarks? One hypothesis is that people perceive landmarks that support, contain, or cover objects as more salient than those that are next to objects, and therefore are more likely to refer to the former types of landmarks before the latter. Thus, when objects are *in* or *under* small landmarks that are *next to* large landmarks, people should nearly always refer to the small landmark before the large landmark. On the other hand, when an object bears a physical connection to both the small and large landmark, the two spatial relations may compete with one another. Thus, when objects are *in* or *under* small landmarks that are *on* large landmarks, people should refer to the small landmark before the large landmark about half of the time.

How does this reasoning apply to the results of Experiment 2? In this experiment, all the objects were placed either *in* or *under* the small landmarks. Half of these small landmarks were *on* the large landmarks and half were *next to* the large landmarks. Thus, for half the locations, the objects remained *on* the large landmarks and for the other half they were *next to* the large landmarks. Following the logic above, this means that subjects should have referred to the small landmark before the large landmark about 75% of the time. That is, they should have referred to the small landmark first in all six cases in which the small landmark was *next to* the large landmark, and in about half of the six cases in which the small landmark was *on* the large landmark. Thus, because subjects often started with the most general spatial unit when giving directions, roughly 75% of messages produced by subjects in the direction-giving group should be quasi-hierarchical. In fact, 63% of messages given by the direction-giving group were quasi-hierarchical. This figure come close to the predicted 75% and suggests that the communication task and landmark organization jointly constrain the structure of spatial messages.

A third experiment was designed to further investigate this hypothesis. Subjects hid objects and later wrote down *directions* for finding those objects. Half of the subjects placed the objects *in* or *under* small landmarks, and the other half placed the objects *next to* those same small landmarks. All of the small landmarks were located *on* the large landmarks. This allowed us to keep the spatial relation between the object and large landmark constant while varying the spatial relation between the object and the small landmark. It should be noted that although the object was not in direct contact with the surface of the large landmark when it was placed *inside* the small landmark, the fact that it remained

supported by the large landmark dictates that it was *on* the large landmark (Herskovits, 1986; Miller & Johnson-Laird, 1976).

On the basis of the results of the two previous experiments, we expected that subjects would usually begin their directions by referring to the floor and then the room. We also hypothesized that the ordering of the large and small landmarks within directions would be influenced by the spatial relations between the object and the small and large landmarks. When the object was *in* or *under* the small landmark, we expected that subjects would mention the large landmark before the small landmark about half of the time. When the object was *next to* the small landmark, we expected that subjects would usually mention the large landmark before the small landmark. As a result, we predicted that subjects would produce more hierarchically organized directions when the object was *next to* rather than *in* or *under* the small landmark.

## Experiment 3

### *Method*

#### *Subjects*

Twenty-eight undergraduates served as subjects in return for course credit in their elementary psychology course. There were equal numbers of males and females in each condition.

#### *Apparatus and Materials*

The same model house as was used in Experiment 2 served as the experimental space. Again, 12 unrelated objects were placed at 12 locations. The pairings of objects and locations were randomized across subjects.

#### *Design and Procedure*

The session began with the same familiarization procedures as in Experiment 2. The second part of the session again involved placing the objects in the model house. Subjects were randomly assigned to either an *in/under* condition or to a *next to* condition. Subjects in the *in/under* condition placed half of the target objects *in* and half of the target objects *under* the small landmark. Subjects in the *next to* condition placed the target objects immediately *next to* those same small landmarks (see the Appendix for a description of the hiding locations). After the experimenter showed subjects where to place the objects, they were asked to turn away while the experimenter removed the objects from the house. The experimenter then handed the objects to the subjects one at a time and asked them to place the objects in their correct locations. This procedure was repeated until subjects completed two successive errorless trials. As in Experiment 2, subjects rarely made any errors after the first errorless trial. The mean number of placement trials was 2.75 with a range from 2 to 4. During the third part of the session, subjects wrote down directions for finding the objects. The same instructions and procedures were used as in the direction-giving condition in Experiment 2.

#### *Coding*

All incorrect messages were excluded from the analyses. The mean number of correct directions given by the *in/under* and *next to* groups was 10.9 and 11.5 out of 12, respectively, $F(1,26) = 1.55$, n.s. The same coding system was used as in the previous experiments to classify each type of spatial unit. On average, 97% of messages in the *in/under* group and 89% of messages in the *next to* group contained three or more spatial units. In addition, directions were coded for whether the small landmark was mentioned before the large landmark. Two coders scored four randomly selected subjects' protocols for reliability purposes. Intercoder agreement for landmark order and organizational structure was 98 and 84%, respectively. Average agreement for references to the floor, floor part, room, room part, large landmark, large landmark part, and small landmark ranged from 92 to 100%

($M$ = 95%). Intercoder agreement for the number of spatial units present was $r$ = .81.

## Results

### Elaborateness of Directions

The first analysis examined whether the spatial relation between the object and the small landmark influenced the total amount of spatial information subjects provided in their directions. There was no significant difference between the *in/under* ($M$ = 3.8) and *next to* ($M$ = 3.7) groups with respect to the mean number of spatial units mentioned, $F(1,26)$ = .36, n.s.

In the process of coding subjects' directions, it became apparent that the organization of landmarks influenced not only the overall structure of directions, but also the content of directions. Therefore, analyses were carried out to compare the two groups with respect to references to different types of spatial units (i.e., floor, floor part, room, room part, large landmark, large landmark part, and small landmark). Scores were calculated by dividing the number of directions containing a reference to each type of spatial unit by the total number of directions. Figure 2 shows the mean proportion of directions containing a reference to each type of spatial unit. No significant differences were found between the two groups for references to floors, $F(1,26)$ = .97, n.s., floor parts, $F(1,26)$ = 1.60, n.s., rooms, $F(1,26)$ = .79, n.s., room parts, $F(1,26)$ = 2.57, n.s., or large landmarks, $F(1,26)$ = 2.92, n.s. However, a significantly greater proportion of directions given by subjects in the *next to* ($M$ = .24) than in the *in/under* ($M$ = .12) group contained a reference to a large landmark part, $F(1,26)$ = 12.85, $p < .01$. In contrast, a significantly greater proportion of directions given by subjects in the *in/under* ($M$ = 1.00) than in the *next to* ($M$ = .38) group contained a reference to the small landmark, $F(1,26)$ = 156.86, $p < .001$. Interestingly, subjects more often ignored the small landmark when the object was placed *next to* it than when the object was placed *in* or *under* it. In place of the small landmark, however, it appears that subjects in the *next to* condition sometimes referred to a part of the large landmark (e.g., "on the dresser on the right side" or "on top of table in the left corner").

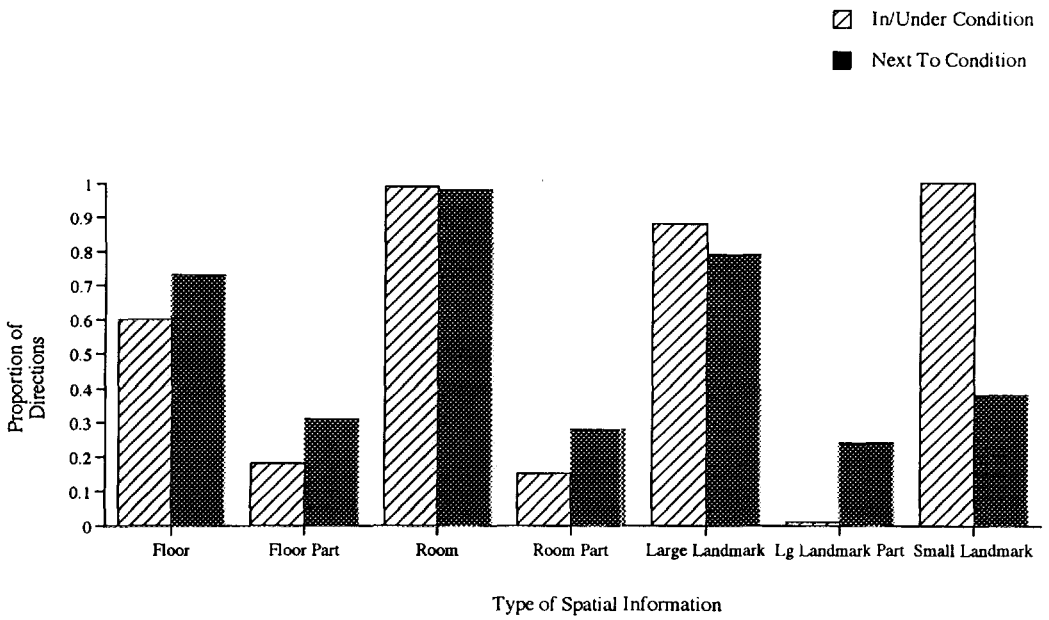


FIG. 2. Mean proportion of directions containing references to specific types of spatial information in Experiment 3.

*Organization of Directions*

Again, the majority of messages produced by subjects were either hierarchical or quasi-hierarchical. In the *in/under* and *next to* groups, organized messages constituted 54 and 67% of messages with three or more spatial units, respectively. As predicted, the *next to* group ($M = .82$) produced a significantly greater proportion of hierarchical messages than did the *in/under* group ($M = .55$), $F(1,26) = 6.80$, $p < .05$.

An analysis of the order in which subjects mentioned the small and large landmarks also was carried out to test our predictions about how the spatial relations that hold between the object and the small and large landmarks influences verbal representation. (It should be noted that this analysis was not completely independent of the previous analysis of hierarchical and quasi-hierarchical organization). Scores were calculated by dividing the number of directions in which the small landmark was mentioned before the large landmark by the total number of directions in which both the small and large landmarks were mentioned. The mean proportion of all directions given by subjects in the *in/under* and *next to* groups in which both the large and small landmarks were mentioned was .88 and .36, respectively. As predicted, subjects in the *in/under* group ($M = .51$) mentioned the small landmark first in a greater proportion of directions than did subjects in the *next to* ($M = .02$) group, $F(1,26) = 36.50$, $p < .001$. In other words, subjects in the *in/under* condition were equally likely to mention the small and large landmark in either order, but subjects in the *next to* condition virtually always mentioned the large landmark before the small landmark. Analyses of chance performance also revealed that when the objects were *next to* the small landmarks, the proportion of directions in which the small landmark was mentioned first was significantly below chance, $t(13) = 20.00$, $p < .001$. When the objects were *in* or *under* those same small landmarks, however, the proportion of directions in which the small landmark was mentioned first did not differ significantly from chance, $t(13) = .07$, n.s.

*Discussion*

These results clearly demonstrate that the communication task and the organization of landmarks within the environment influenced how subjects structured their spatial messages. As predicted, the proportion of hierarchical directions was greater in the *next to* group than in the *in/under* group. Furthermore, when the object was *next to* to the small landmark, subjects virtually always mentioned the large landmark before the small landmark. This was not the case when the object was *in* or *under* the small landmark. Subjects were about equally likely to mention the small landmark before the large landmark as they were to mention the large landmark before the small one. Quite unexpectedly, subjects also were more likely to ignore the small landmark when the object was *next to* than *in* or *under* it.

One obvious reason why subjects might have ignored small landmarks when the target objects were *next to* to them is that the objects were in plain sight. Hence, subjects may have thought it unnecessary to mention the small landmarks. Experiment 4 tested whether the visibility of the target object or the spatial relation between the object and the small and large landmarks was the determining factor in whether subjects were more likely to omit the small landmark from their directions. Subjects again placed objects in the model house and later wrote down directions for finding those objects. Half of the subjects placed the target objects *next to* the small landmarks and the other half placed the objects *on* the same small landmarks. Thus, the target objects were clearly visible in both conditions, but the connection between the target objects and small landmarks in one condition involved the spatial relation of support and in the other condition again involved the relation of proximity.

## EXPERIMENT 4

### *Method*

#### *Subjects*

Twenty-eight undergraduates participated in return for course credit in their introductory psychology course. There were equal numbers of males and females in each condition.

#### *Apparatus and Materials*

The same model house as before served as the experimental space. Again, 12 unrelated objects were placed at 12 locations. The pairings of objects and locations were randomized across subjects.

#### *Design and Procedure*

The procedures were identical to those of the previous experiment. Subjects were randomly assigned to either an *on* condition or to a *next to* condition. Subjects in the *on* condition placed the target objects *on* the small landmark, and subjects in the *next to* condition placed the target objects immediately *next to* those same small landmarks (see the Appendix for a description of the hiding locations). All small landmarks were *on* the large landmarks. The mean number of placement trials during the training phase was 2.71 with a range from 2 to 6.

#### *Coding*

All incorrect messages were excluded from the analyses. The mean number of correct directions given by the *on* and *next to* groups was 11.2 and 11.3 out of 12, respectively, $F(1,26) = .03$, n.s. The coding system from the previous experiments was used to classify each type of spatial unit. Directions were classified as either hierarchical, quasi-hierarchical, or unorganized. Directions also were coded for whether the small landmark was mentioned before the large landmark. Again, only descriptions containing three or more spatial units were included in the analysis of hierarchical structure. On average, 94% of messages in the *on* group and 91% of messages in the *next to* group contained three or more spatial units. Two coders scored six randomly selected subjects' protocols for reliability purposes. Intercoder agreement for landmark order and organizational structure was 93 and 85%, respectively. The average agreement for references to the floor, floor part, room, room part, large landmark, large landmark part, and small landmark ranged from 88 to 100% ($M = 94\%$). Intercoder agreement for the number of spatial units present was $r = .93$.

### *Results*

#### *Elaborateness of Directions*

As in the previous experiment, there was no significant difference between the two spatial relation groups with respect to the mean number of spatial units mentioned, $F(1,26) = .16$, n.s. Subjects in the *on* and *next to* conditions mentioned 3.72 and 3.62 spatial units, respectively.

We again examined whether subjects in the two spatial relation conditions included different types of spatial units in their directions. Figure 3 shows the mean proportion of directions containing a reference to each type of spatial unit. One-way ANOVAs comparing the two groups on the proportion of directions containing a reference to each type of spatial unit again revealed no significant differences for references to floors, $F(1,26) = .55$, n.s., floor parts, $F(1,26) = 00$, n.s., rooms, $F(1,26) = .51$, n.s., room parts, $F(1,26) = 2.20$, n.s., or large landmarks, $F(1,26) = .50$, n.s. As in Experiment 3, however, a significantly greater proportion of directions in the *next to* ($M = .12$) than in the *on* ($M = .02$) condition contained a reference to a large landmark part, $F(1,26) = 11.56$, $p < .01$. In contrast, a significantly greater proportion of directions in the *on* ($M = .90$) than in the *next to* ($M = .60$) condition contained a reference to the small landmark, $F(1,26) = 11.75$, $p < .01$. Thus, subjects more often ignored the small landmark when the object

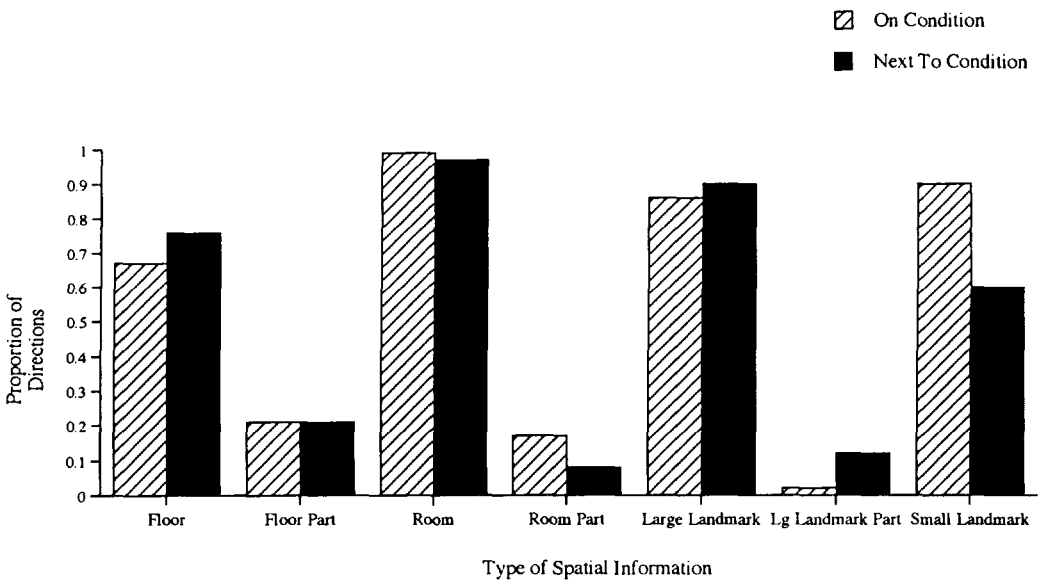


FIG. 3. Mean proportion of directions containing references to specific types of spatial information in Experiment 4.

was placed *next to* it rather than *on* it even though the object was clearly visible in both situations. Again, it appears that subjects in the *next to* condition substituted references to a part of the large landmark in place of references to the small landmark (e.g., "look on the table on the front left corner").

### *Organization of Directions*

Organized messages constituted 69 and 70% of messages with three or more spatial units produced by subjects in the *on* and *next to* groups, respectively. As expected, the proportion of hierarchical messages was significantly higher for the *next to* group ($M = .86$) than for the *on* group ($M = .45$), $F(1,24) = 14.75$, $p < .001$. (Two subjects were excluded from the *next to* group because they provided no hierarchical or quasi-hierarchical directions).

The mean proportion of directions given by subjects in the *on* and *next to* groups in which both the large and small landmarks were mentioned was .81 and .57, respectively. The proportion of small before large landmark references was significantly higher for the *on* ($M = .58$) than for the *next to* ($M = .15$) group, $F(1,25) = 18.72$, $p < .001$. (One subject from the *on* condition was excluded because none of his/her directions contained references to both the small and large landmarks). Analyses of chance performance also revealed that when the objects were *next to* the small landmarks, the proportion of directions in which the small landmark was mentioned first was significantly below chance, $t(13) = 7.75$, $p < .001$. When the objects were *on* those same small landmarks, however, the proportion of directions in which the small landmark was mentioned first did not differ significantly from chance, $t(13) = .89$, n.s. Thus, subjects in the *on* condition were equally likely to mention the small and large landmark in either order, but as in Experiment 3, subjects in the *next to* condition almost always mentioned the large landmark before the small landmark.

### *Discussion*

The results of this experiment replicate and extend those of Experiment 3 by show-

ing that the visibility of the target object did not determine whether subjects mentioned the small landmark. Rather, the critical factor appears to be the type of spatial relation that connects the object to the small landmark. Although the target objects were clearly visible when placed either *on* or *next to* the small landmarks, subjects were more likely to mention the small landmark when it provided a surface of support than when it was proximal to the target object. Thus, it appears that supporting small landmarks are more likely to be communicated than are proximal small landmarks. Subjects in the *next to* group again produced more hierarchical directions than did subjects in the *on* group. Subjects also organized the small and large landmarks in their directions differently depending on the spatial relation between the object and the small and large landmarks. When the object was *next to* to the small landmark, subjects were more likely to mention the large landmark before the small landmark (e.g., "on the table next to the cookbook") than vice versa. When the object was *on* the small landmark, however, subjects were about equally likely to mention the large landmark before the small landmark as they were to mention the small landmark before the large landmark.

## General Discussion

The results of the present investigation considerably broaden our understanding of how people communicate about object locations. Clearly, speakers selected more than one landmark or spatial region to communicate about the location of an object. These spatial units virtually always were of varying levels of generality. In these experiments, speakers usually referred to the floor, the room, a large landmark, and a small landmark (see Figs. 2 and 3). How speakers organized these spatial units relative to one another was a product of both the task and the structure of the environment. When the task involved giving directions, subjects usually began their messages with a reference to the floor and the room. The order in which they referred to the landmarks, however, was influenced by the spatial relation between the object and the small and large landmarks. When the object was *on* the large landmark and *next to* the small landmark, subjects almost always mentioned the large landmark first. The result was often a hierarchically organized direction (e.g. "look in the basement in the laundry room on the washer next to the dustpan"). When the object was *on* the large landmark and *in, on,* or *under* the small landmark, subjects mentioned the large landmark before the small landmark about half of the time. This resulted in roughly half hierarchical directions (e.g., "look on the first floor in the living room on the coffee table on the magazine"), and half quasi-hierarchical directions (e.g., "look on the first floor in the living room on the magazine on the coffee table").

These results show that people are sensitive to whether the communication task is to tell someone *how* to find something, or where something *is*. When asked to provide information about how to find something, speakers started out with largest spatial region and worked progressively toward the object. Thus, it appears that people try to convey spatial information in the order in which it will be encountered by the listener. Experiments 2–4 show that this convention holds even for small-scale spaces. That is, speakers usually draw the listener's attention to the floor and the room before the landmarks within the room. When asked to describe where something is, however, speakers often started out with the object itself and worked progressively backward to the largest spatial region.

Why did speakers treat the task of describing where something is differently from the task of describing how to find something? First, it is important to note that how speakers interpret requests for information about location may be contextually determined. For example, speakers may interpret identical requests very differ-

ently depending on how familiar they perceive the listener to be with the space. In short, when a listener is unfamiliar with a space, a question like "where did you park the car?" may well be interpreted as "could you tell me how to find the car?" This then would elicit a set of directions beginning with the largest spatial unit and working toward the smallest spatial unit. The same request from a listener who is familiar with the space, however, may be much more likely to elicit a simple declarative statement about where the car is. This suggests that the context may influence whether speakers treat giving directions and describing locations similarly.

The results of the present investigation, however, indicate that people treated the two tasks differently even when they were writing messages for a naive listener. What accounts for this? Although both tasks involve communicating spatial knowledge, they may differ in terms of pressure to take the listener's perspective. That is, taking the listener's perspective may be obligatory when giving directions for how to find something, but optional when describing where something is. As a result, when giving directions, speakers may feel compelled to convey spatial units in the order in which they will be encountered by the listener. When describing were something is, speakers may opt for what is easiest for them to do, or in this case, conveying spatial information in an ascending order. Schober (1993), in fact, found that speakers tended to use their own perspective ("on my left") rather than their listener's perspective ("on your right") when describing locations. Quite likely, speakers found it easier to use their own perspective than to engage in the transformations necessary to use their listener's perspective. Similar processes may have operated in the present investigation that may account for why people treated giving directions and describing locations as different tasks.

Why might it be easier for speakers to convey units of spatial information in an ascending rather than in a descending order? One possible reason concerns how object locations may be represented and retrieved from memory. If one assumes a strict hierarchical model of spatial memory (e.g., Hirtle & Jonides, 1985; McNamara, 1986; Stevens & Coupe, 1978), then priming of spatial information should occur more quickly in an order of ascending than descending size of spatial unit. That is, there are fewer possible locations to consider at each level of the hierarchy when retrieving spatial information in an ascending than descending order. Consider the following examples of retrieval orders: (1) keys → on book → on table → in dining room → on first floor; and (2) keys → on first floor → in dining room → on table → on book. In the first order, there is likely only one location to consider when moving up to each subsequent level in the decision tree. That is, the book is linked directly to the table, the table is linked directly to the dining room, and the dining room is linked directly to the first floor. In the second order, however, there may be many possible locations to consider when moving down to each subsequent level in the decision tree. For example, when moving from the floor to the room level, there may be several rooms on the first floor to consider when trying to retrieve the correct room from memory. Similarly, there may be several objects on the table to consider when trying to retrieve the correct small landmark. These competing possible locations at each level of the hierarchy may make it more difficult to retrieve information about object locations in a descending order. Of course, these ideas are speculative and remain to be tested.

What do the present results tell us about spatial cognition? As others recently have argued (e.g., Landau & Jackendoff, 1993), we believe that the way that people communicate about location can tell us something about how they think about location. In the present experiments, the spatial relation between the object and the small and

large landmarks influenced the order in which subjects referred to landmarks and quite unexpectedly, whether subjects referred to the small landmark in their directions. Subjects rarely mentioned proximal small landmarks before supporting large landmarks. When the small landmarks supported, contained, or covered the object, however, subjects were equally likely to mention the small and large landmarks in either order. Moreover, like young children (Clark, 1980; Plumert et al., in press), adults were more likely to mention landmarks when they supported, contained, or covered the object than when they were proximal to the object. The fact that the placement of objects relative to landmarks had a profound influence on communication about those locations points to general conceptual biases extending from childhood through adulthood in how people code object locations.

An alternative explanation for these results is that people encoded proximal landmarks just as well as the other types of landmarks, but that they chose not to include proximal landmarks in their directions because they thought that such landmarks would be unhelpful to a listener. Instead, they sometimes referred to a smaller region that was part of the large landmark (e.g., "it's on the table on the front left-hand corner"). However, it is not clear why the subjects in these experiments would think that references to proximal small landmarks would be unhelpful to a listener. A more likely explanation for these findings is that subjects were less likely to code objects in relation to small proximal landmarks. Support for this position comes from recent work with 3- and 4-year-olds showing that they have more trouble remembering the locations of objects when those objects are *next to* than *on* landmarks (Plumert et al., in press). Further work on adults' memory for different types of landmarks may well reveal similar biases in the coding of object locations.

It is important to point out, however, that these hypothesized biases may be restricted to coding object location. One might think of the location of a restaurant, for example, as *in* the downtown area *next door* to the art gallery. In cases such as these, it seems likely that proximity relations would play an important role in the coding and communication of location. In part this may be due to the fact that containment and proximity are typically the only spatial relations that apply to locations such as buildings. That is, buildings are usually thought of as *in* regions and *near* landmarks. Alternatively, people may be more willing to rely on proximity relations when landmarks are very stable. Further research is needed to determine whether there are differences in people's willingness to rely on proximity relations for coding the locations of objects versus places.

In sum, the results of this investigation underscore the importance of pragmatic factors and conceptual biases for determining how people communicate about object locations. These results raise several questions as well. For example, how do the characteristics of the listener influence the content and organization of spatial messages? Are people faster to comprehend messages about object locations in which the spatial information is conveyed in an ascending rather than in a descending order? What are the origins of biases in coding object locations? That is, do they arise from our perceptual or from our linguistic experiences with spatial relations? Answers to these and other questions raised here about the nature of spatial discourse may provide further insight into the factors that influence communication about object locations, and into the relations between spatial cognition and spatial language.

## Appendix

### *Object Locations in Experiments 3 and 4*

#### *Experiment 3*

In the playroom on the pool table under (next to) the monopoly board.

In the master bedroom on the dresser under (next to) the hat.
In the child's bedroom on the nightstand under (next to) the helmet.
In the sewing room on the table under (next to) the wicker fan.
In the upstairs bathroom on the bathtub under (next to) the towel.
In the office on the chair under (next to) the magazine.
In the laundry room on the washer in (next to) the tub.
In the downstairs bathroom on the toilet in (next to) the basket.
In the living room on the coffee table in (next to) the plant.
In the kitchen on the table in (next to) the red pot.
In the dining room on the china cabinet in (next to) the white pitcher.
In the workroom on the workbench in (next to) the black garbage can.

*Experiment 4*

In the workroom on the workbench on (next to) the sled.
In the office on the chair on (next to) the doritos.
In the playroom on the pool table on (next to) the monopoly game.
In the laundry room on the washer on (next to) the dustpan.
In the kitchen on the table on (next to) the cookbook.
In the dining room on the china cabinet on (next to) the tray.
In the downstairs bathroom on the toilet on (next to) the bag.
In the living room on the coffee table on (next to) the magazine.
In the master bedroom on the dresser on (next to) the hat.
In the sewing room on the table on (next to) the fabric.
In the upstairs bathroom on the bathtub on (next to) the towel.
In the kid's bedroom on the bed on (next to) the skateboard.

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