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Running head: TRANSFER OF RELATIONAL MAPPING

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Abstract

To use a symbol as a source of information, one must recognize that the symbol stands for something other than itself. One must also use information derived from the symbol to draw inferences about its referent (i.e., mapping). Many symbols are comprised of multiple elements, and the relations among these elements must correspond to the relations among the represented entities. For example, the lines and squares on a map must correspond relationally to the roads and buildings they depict. The purpose of this study was to investigate young children's ability to map between a symbol and its referent when doing so requires the use of multiple relations. Specifically, the study examined the role that experience with other tasks that involve relational correspondence has on relational mapping in a symbolic task. Twelve 3-year-olds (Transfer Group) received training on array reconstruction and drawing tasks that emphasized relational correspondence. A Control Group received equivalent training, but relational correspondence was not emphasized. The training on relational correspondences had no impact on the symbolic task that required relational mapping. The current findings and further directions for research are discussed.

Transfer of Relational Mapping Between
Different Symbol Systems in Young Children

The importance of symbols is demonstrated by the fact that they are found in many different settings. From courtrooms to classrooms, symbols are used to convey meaning and to provide information. Lawyers, for example, use diagrams and photographs to illustrate crime scenes, while teachers use numerals and globes to teach math and geography. Symbols are often used in leisure activities as well, as when a tourist uses a map to find points of interest, or when a child draws a picture of himself.

Using and understanding symbols is easy for most adults. When we encounter a symbol, we immediately think of what it represents rather than focus on the characteristics of the symbol itself. When a person sees a stop sign, he or she automatically comes to a stop, rather than ponder the color and shape of the sign. Children, however, often find using symbols difficult. Sometimes they do not recognize that a symbol represents anything at all. When given a map, for example, a child might scribble on it, because he or she views it as a mere piece of paper. In other cases, they may recognize a symbol, but fail to use it properly. For example, some children, when given a map of a town, said that a baseball diamond represented a guitar (Liben & Downs,1989). A major developmental hurdle for children, therefore, involves learning about the symbols that are an integral part of their culture.

In the first years of life, infants and children are exposed to many different kinds of symbols. Their parents read picture books to them and show them family photos. In preschool, children begin to understand the symbolic nature of numbers, letters, and calendars (Fuson, 1988; Gelman, 1978; Gelman & Gallistel, 1978; and Wynn, 1990). Later, they begin to use more complex symbols such as maps, graphs, and perhaps musical notation. The goal of the present research is to further investigate very young children's understanding and use of symbols.

One important function of many symbols is to serve as a source of information

about their referents. By looking at a portrait, for example, one can infer certain characteristics of the person depicted, such as eye color. By examining a map, one can determine the relative locations of represented cities and the shortest routes between them. By reading musical notation, a person knows which notes to play or sing. To use a symbol as a source of information, one must achieve "representational insight" (DeLoache, 1987; DeLoache, 1991; DeLoache & Marzolf, 1992). That is, one must appreciate that the symbol stands for something else. To use a photograph, for example, one must understand that it corresponds to a specific entity, such as a person. Likewise, to use a map, a person must know that it represents a specific geographic location.

DeLoache and her colleagues have investigated how children achieve representational insight (DeLoache, 1987, 1989,1991; DeLoache, Kolstad & Anderson, 1991). They employed an object retrieval task in which young children were asked to find a toy hidden in a room after seeing a miniature version of the toy hidden in a scale model of the room. (Half of the children saw the toy hidden in the scale model and then found the toy in the room, while the other half saw the toy hidden in the room and found the toy in the scale model. For ease of presentation, we describe only the former order.) To succeed in this task, children must have insight that the model corresponds to the room.

The room contains familiar items of furniture, such as a couch, a dresser, and a chair. In the standard task, the objects in the model are similar to the objects in the room, including the color and texture of the furniture. Also, the objects in both spaces are arranged in the same way, and the model is always aligned with the room. The model is always located outside of the room so that the child cannot see the interior of both spaces at the same time.

First, the children go through an orientation with the experimenter. They are introduced to two toys (e.g., Big Snoopy and Little Snoopy), which are identical except for size. The experimenter shows the children the room and the scale model, labeling the items of furniture in each of the spaces. The experimenter refers to the room as "Big

Snoopy's room," and the scale model as "Little Snoopy's room." The experimenter demonstrates the relation between the spaces by indicating each pair of corresponding objects. For example, the experimenter holds the miniature chair to the big chair and says, "Look, here's Little Snoopy's little chair and here's Big Snoopy's big chair. They're just the same, except one is little and the other is big." After the miniature items are returned to the model, the experimenter demonstrates that corresponding events occur in both spaces by placing the miniature toy somewhere in the model (e.g. on a table) and asking the child to place the large toy in the "same place" in the room.

The orientation is followed by a number of test trials. On each trial, the child watches as the experimenter hides the miniature toy in the model. (The toy is hidden behind or under a different item of furniture on each trial.) The experimenter then tells the child that she is going to hide Big Snoopy in the "same place" in the room. The child waits by the model while the large toy is hidden in the room. The experimenter reminds the child that the large toy is in the same place as the small toy and then asks the child to retrieve the large toy. The child searches until the toy is found, but only the first search is counted as correct.

This retrieval, called the Symbolic Retrieval, is the critical component of the model task. Successful performance indicates that the child has representational insight into the model-room relation. Further, success on the Symbolic Retrieval demonstrates their ability to map information (i.e., the location of the toy) from one to the other.

After finding the large toy in the room on each trial, the child returns to the model to retrieve the hidden toy. This Memory Retrieval is important to interpret children's performance on the Symbolic Retrieval. If the children remember where the miniature toy is hidden, yet still fail to find the large toy in the room, it suggests that they do not appreciate the relation between the two spaces.

In the standard model task, both the 2.5 and 3-year-olds were successful at

the Memory Retrieval. This means that both groups remembered where the original toy was hidden. The performance of the two age groups on the Symbolic Retrieval, however, was very different. The 3-year-olds were successful at the Symbolic Retrieval (DeLoache,1987). They achieved representational insight. That is, they understood that the scale model was related to the room. Further, they were able to map information from one to the other.

The 2.5-year-olds' performance on the Symbolic Retrieval, however, was poor. They knew where the toy was hidden, but they did not infer the location of the toy in the room, which can be interpreted to suggest that they lacked representational insight. These results have been replicated several times by DeLoache and her colleagues (DeLoache, 1989, 1991; DeLoache et al., 1992; Marzolf & DeLoache, 1994), as well as by other researchers (Blades, 1991; Dow & Pick, 1992).

Success at the model task requires <u>dual representation</u> of the model. That is, the child must think of the model in two ways--as an object and as a symbol--at the same time. One potential reason why the 2.5-year-olds were not successful at the model task is that the model is salient as an object, and therefore difficult to think of as a symbol.

To test the dual representation hypothesis, DeLoache presented 2.5-year-old children with a similar symbolic task that did not require dual representation (DeLoache, 1987). She used pictures to convey the location of the toy rather than a scale model. Pictures are not very salient as objects in and of themselves. Furthermore, even very young children have much experience with the symbolic function of pictures. Thus, pictures do not require dual representation in the same way that scale models do (DeLoache, 1987, 1991; DeLoache & Burns,1994).

In the picture task, children are required to retrieve a toy hidden in a room based on information derived from a photograph or color drawing of the room. The experimenter points to the hiding place in the picture, then the child goes to the room to retrieve the toy. The 2.5-year-olds are successful in this task (DeLoache 1987). They

recognize that the picture corresponds to the room and use it to infer the location of the toy. Thus, they achieve representational insight when the symbol does not require dual representation.

During experimentation, DeLoache (1987) found that children who received the picture task prior to the model task were more successful at the model task than if the model task had been given first (DeLoache, 1987). Once the children had experience with an easy symbol-referent relation, they seemed more sensitive to more difficult ones. This suggests another possible reason why the 2.5-year-olds have difficulty with the model task-- they have less experience with symbols than do older children.

Marzolf and DeLoache (1994) directly examined the role of symbolic experience in a series of transfer studies. In each of the studies, children were first given a symbolic task that children their age typically understand. The next day, the same children were given a task that children their age typically fail. In one of the studies, for example, 2.5-year-olds were given an easy model task on one day, and a task involving an abstract map on the second day. The map was an aerial view, with simple colored figures that represented the pieces of furniture. The experimenter simply pointed to the map to indicate where the toy was hidden in the room, and the children went into the room to find the toy. The children were successful on both tasks. A control group performed poorly on the map task on two consecutive days. Therefore, experience with an easier symbol-referent relation appeared to help children recognize a more difficult symbol-referent relation. Several transfer studies yielded similar results, even with inter-task delays as long as a month (Marzolf, Pacha, & DeLoache, 1996.)

To succeed in the model task, one must achieve representational insight. That is, one must recognize that a symbol, as a whole, corresponds to another object or set of objects. This is difficult if the symbol is also salient as an object, and hence requires dual representation. Also, experience with other symbols can help young children recognize more difficult symbol-referent-relations.

Representational insight is necessary to use a symbol as a source of information, but it is not sufficient. One also has to map information from one to the other. Mapping involves using information derived from a symbol to draw inferences about its referent (Marzolf, 1996). By looking at a portrait, for example, one can infer the gender of the depicted person. One can achieve representational insight, yet have difficulty mapping information between the symbol and its referent. For example, most adults understand that a map of a mall corresponds to that mall, yet some might find it difficult to use the map to find a particular store (i.e., perform a mapping).

In the model tasks described so far, the children only had to map one relation from the model to the room, (i.e., Snoopy is behind the dresser). With many symbols, one has to map multiple relations. To assemble a bicycle, for example, one must not only identify the pieces on the assembly diagram that correspond to the numerous parts on the floor, but also represent the relations among the features, and use them as a basis for determining how the actual parts go together. Likewise, for one to use letters to form a word, one must pay attention to the arrangement of the letters in the word. Otherwise, one would form nonsense words with no meaning.

Recently, Marzolf (1996) investigated young children's ability to map multiple relations in the model task. He did so by adding four identical boxes to the model and the room and using them as the hiding places. The boxes were located next to or on top of individual items of furniture (e.g. next to a chair, on a floor pillow, etc.) To succeed at this task, the children needed to map multiple relations. Mapping the single relation between the toy and its immediate hiding place (i.e., "in the box") would be useless because several identical boxes were present. Instead, they had to represent and map two relations- the toy-box relation and the box-landmark relation. That is, the child had to encode "the toy is in the box to the left of the chair."

The procedures in this study were the same as in the previous model studies. An extensive orientation was followed by several test trials, during which the toy was hidden

in a different box on each trial. After retrieving the toy in the room (Symbolic Retrieval), the children were required to return to the model to retrieve the miniature toy they had seen hidden (Memory Retrieval).

Four-year-old children were very successful at this task. Three-year-olds, on the other hand, performed poorly. They always looked in a box in the room, but seemed not to know which was the correct one. Remarkably, children this age perform very well when the toy is hidden behind a chair, but not when the toy is hidden in a box next to the chair. The same children, however, were successful at the Memory Retrieval. This indicates that they represented each of the necessary relations, (i.e., the toy-box relation and the box-landmark relation), yet did not map them both from the model to the room.

To succeed at the box task, the children had to represent and coordinate three relations: the higher-order model-room relation, the toy-box relation, and the box-landmark relation. The three-year-olds represented each of these relations, yet failed to coordinate them to successfully map between the spaces.

According to Marzolf (1996), representing each of these relations requires some cognitive effort. The child must make some effort to remember that the model is related to the room, that the toy is in a box, and that the box is next to some piece of furniture. Marzolf has suggested that further coordinating these relations to perform a mapping is beyond the bounds of young children's limited cognitive capacity.

According to this argument, if one of these relations is easier to represent (i.e., requires less cognitive capacity), then coordinating the multiple relations to perform a mapping might be within the limits of the child's cognitive capacity. One way in which Marzolf tested this possibility was to give 3-year-olds a similar task in which the location of the toy was conveyed via a picture. Picture-referent relations do not require dual representation, and young children are more familiar with pictures as symbols. Hence, representing a picture-referent relation should require less cognitive effort, and 3-year-old

children might then be able to coordinate the multiple relations necessary to succeed at the box task.

The procedures were the same as previous picture studies (DeLoache, 1987), with the addition of the white boxes as the hiding places. The photographs showing the hiding places included both the box and a distinctive landmark (i.e., a piece of furniture). The experimenter indicated the hiding place by pointing to the box in one of the pictures and saying, "Snoopy is hiding right here."

The 3-year-olds tested in the picture task were highly successful. They represented and coordinated the higher-order model-room relation, the toy-box relation, and the box-landmark relation required in the task. The important difference between the picture task and the model task is the nature of the higher-order symbol-referent relation. Representing the relation between a picture and its referent is easier than representing the relation between a scale model and its referent. Hence, coordinating the multiple relations in this task is within the child's limited cognitive capacity.

Marzolf (1996) tested 3-year-olds to see whether experience with mapping multiple relations would transfer to more difficult tasks. Three-year-old children were first presented with the picture task described above, followed one day later by the model task. In both tasks, identical white boxes were used as hiding places. Transfer occurred-- the children were successful in both tasks. Mapping multiple relations in a less difficult task seemed to make it easier to map multiple relations in a more difficult one.

The purpose of this study was to further examine the role of experience in symbolic development. The study was designed to investigate the possibility that transfer occurs between very different kinds of tasks that involve relational correspondence. If experience with relational mapping in one symbolic task influences performance in a very different symbolic task, then this would indicate a very general understanding of relational correspondence.

In this study, two groups of 3-year-old children were given training prior to receiving the model task that involves multiple relations (i.e., the box task). A Transfer Group received training that emphasized relational correspondence. In one task, they were asked to reconstruct arrays of distinctive blocks placed on a 3 x 3 paper grid. The goal was to demonstrate that the relations among the blocks on the child's grid should be the same as those among the blocks on the experimenter's grid. The goal of the second training task was the same, except children were asked to draw simple arrays that contained two or three two-dimensional geometric forms (e.g., blue circle, red square, etc.) placed on a piece of paper. Previous research indicates that children often fail to include relational information in their drawing (Cox, 1978; Freeman, Eiser, & Sayers, 1977; Ingram, 1983, 1985; Light & MacIntosh, 1980). The Control Group received similar training, except relational correspondence was not emphasized. In the block task, the experimenter simply placed a single block on a plain piece of paper and asked the child to select the block that matched it. In the drawing task, the experimenter asked the child to draw a single figure. Thus, both groups received equivalent training, with the exception of whether relational correspondence was emphasized.

Following the training session, both groups were given the model task in which identical boxes were used as hiding places (Marzolf, 1996). The same procedures were used, with one additional component. After the miniature objects were removed from the model during the orientation, the children were asked to replace them in the model so that it was "just like the room." This model reconstruction was intended to provide an additional measure of children's appreciation of relational correspondence.

We expected the Transfer Group to perform better than the Control Group on both the model reconstruction and object retrieval components of the task. Presumably, emphasizing relational correspondence during the training session would lead children to focus on relational correspondence in the model task.

Method

Participants

The subjects were 24 children, (12 girls and 12 boys), between the ages of 35 and 40 months. Names of potential subjects were obtained from letters sent to local preschools and from archived newspaper birth announcements. The resulting samples were predominately white and middle-class. Equal numbers of boys and girls were randomly assigned to the Transfer and Control Groups. The mean age within each group was nearly the same (37.33 months and 37.58 months, respectively).

Apparatus and procedure

The children were tested individually. They were escorted to the lab by their parents, and given a number of puzzles to play with to make them comfortable with the space and with the experimenters. Consent from the parents was obtained at this time. The training tasks began when the children appeared comfortable. The Transfer Group was given the training tasks that emphasized relational correspondence. In the matching task, the experimenter and child each had a set of five distinct blocks that varied in shape and color (e.g., a blue cube, a green cylinder, etc.) and a piece of white poster board on which was drawn a three-by three grid. The experimenter explained to the child that she was going to place some of her blocks on her piece of paper and that the child was to place his or her blocks so that they were "just the same" (Figure 1). Four arrays were used, and the order of presentation was random. Three of the arrays involved three blocks, and the other array involved four blocks. When the child placed a block in the wrong location on the grid, the experimenter reminded the child that his or her blocks should be placed just like the experimenter's. If the child incorrectly placed the block again, the experimenter placed it in the correct location and showed the child how it corresponded to the base array.

This task was followed by the drawing task. For the Transfer Group, the experimenter placed two or three paper cutouts of various shapes in a particular

arrangement (e.g., a blue square above a red triangle) on a blank piece of paper (Figure 2). The child was asked to draw this array on his or her own piece of paper. The experimenter drew the first shape in the first array to make sure the child understood the directions. For each shape, the experimenter asked the child where he or she planned on drawing the shape. If the child seemed to randomly place the shape, the experimenter corrected the child by suggesting that he or she draw the shape in its correct position.

The Control Group received similar training tasks, but relational correspondence was not emphasized. On the matching task, the three-by-three grid was turned over, so that the piece of poster board was now blank. The experimenter placed one block on the piece of paper and asked the child to do the same with his or her marching block. This was repeated for each of the five blocks. The drawing task was similar, in that each figure was presented by itself. Thus, children in the Control Group had equivalent experience with matching and drawing, but neither of the training tasks involved relational correspondence.

Following the drawing task, both groups received the model task. The furniture in the room consisted of a couch, a chair, a coffee table, an end table, a floor pillow, and four identical white boxes, which were used as the hiding places. The boxes were located on top of or immediately next to landmarks (Figure 3). The model contained highly similar (i.e., same perceptual features) miniature versions of the items in the room. The items within the spaces were arranged in the same way, and the spaces were aligned. The model was situated outside the room such that the interiors of both spaces could not be viewed simultaneously. Two toys - a large stuffed tiger and a miniature tiger - served as the target objects.

The procedures were the same as in previous model studies, with the addition of the model reconstruction component at the end of the orientation. During the orientation, the experimenter demonstrated each object correspondence by taking the miniature objects from the model and directly comparing them to their counterparts in the room and

commenting on the similarity, for example "Look, here's Little Tiger's chair and here's Big Tiger's chair. They're just the same, except one is little and the other is big." The experimenter then brought the scale model into the room, and asked the children to put the miniature furniture back in the model so that "Little Tiger's room looks just like Big Tiger's room." Errors were not corrected during the model reconstruction. After the miniature items were placed in the model, it was returned to its original position outside the room. The experimenter then demonstrated that corresponding events occur in both places by placing the miniature toy on the table, and asking the child to place the large toy in the "same place" in the room (placement trial). If the child placed the toy incorrectly, the experimenter corrected the child and reminded him or her of the correspondence between the model and the room.

Four test trials followed this orientation. On each of these trials, the child watched as the miniature toy was hidden in the model, and then searched for the large toy in the room (Symbolic Retrieval). (Half of the children saw the toy hidden in the scale model and then found the toy in the room, while the other half saw the toy hidden in the room and found the toy in the scale model.) The child was allowed to search for the toy until it was found. However, only the first search was counted as correct or incorrect. If the child did not find it on the first try, then the experimenter gave prompts, such as, "Do you remember where Little Tiger is? Big Tiger is hiding in the same place." Following the Symbolic Retrieval, the child was asked to return to the model, and find the hidden miniature toy (Memory Retrieval). Again, the child was allowed to search until he or she found the toy, and was prompted each time he or she looked in the wrong place. Throughout testing, one experimenter interacted with the child, while a second experimenter recorded the child's performance on a structured data sheet.

Results

Children's performance on the training tasks, model reconstruction, and object retrieval were of primary importance. To assess the degree to which the children were

correct on the matching task, an experimenter noted the children's placement of each block, and the number of prompts given. The children received 1 point each time they placed a block in the correct location the first time, without receiving any prompts. The total possible number of points each child in the Transfer Group could receive was 13. As a group, their performance was mediocre (62% correct placements). There was significant variability in children's performance on this task. Some children performed very well, whereas others performed poorly. We did not change the matching task, because a number of children were successful, and most appeared to catch on near the end of training. For the Control Group, the total number of points each child could receive on the block matching task was 5. This seemed to be an easier task because all the children correctly matched each block.

Performance on the drawing task was quite poor. Children in the Transfer Group grew frustrated and typically did not draw more than two of the arrays. Even the children in the Control Group became frustrated with this task, even though they were required to draw only a single figure. Most of the children were frustrated that they could not draw the particular shape. For these reasons, performance on this task was difficult to interpret, and hence of little use for the current purposes.

A coding scheme was developed to assess the degree to which the children placed the furniture in the model in the same spatial arrangement as the furniture in the room during the model reconstruction task. During testing, the experimenter produced a schematic of the model as the child placed the items of furniture. Two blind raters then compared the schematic with a key that showed how the objects should be arranged. A template was placed over the schematic, and a point was awarded for each item that was over 50% in its proper location. The raters watched for systematic scale transformations and entire space rotations, but none were found. Thus, a total of 5 points was available. The performance of both the Transfer Group and Control Group was low (35% and 32 %, respectively. Their performance was not significantly different.

The dependent variable for the object retrieval tasks was the number of errorless retrievals. A subject was awarded one point for each of the four trials on which he or she found the toy in the first place searched without receiving any prompts from the experimenter. Thus, an individual child's score could range from 0 to 4.

Retrieval performance was analyzed in a 2 (Group: Transfer vs. Control) x 2 (Gender) x 2 (Retrieval: Symbolic vs. Memory) repeated-measures ANOVA, with Retrieval as the within-subjects variable. The main effect of Retrieval, $F(1,20)=60.63$, $p<.001$, was the only significant result. The results are shown in Figure 4. Both groups were very successful on the Memory Retrieval (Transfer Group: 94%; Control Group: 88%), but performed relatively poorly on the Symbolic Retrieval (Transfer Group: 42%; Control Group: 40%). The pattern of individual performance data supported the group analyses. Every child scored either a three or a perfect four on the Memory Retrieval. Performance on the Symbolic Retrieval was more varied. Three of the twelve children in the Transfer Group got three trials correct, three got two correct, five got one correct, and the remaining child was never correct. One of the twelve children in the Control Group got all four trials correct, three children got three correct, two got two correct, two got one correct, and the remaining four children were never correct.

In summary, both groups remembered the location of the original toy, yet failed to use relational correspondence to map between the spaces. These results replicate those reported by Marzolf (1996). However, the hypothesized transfer effect did not occur. The Transfer group did not perform better on the model task following their training on relational correspondence.

Discussion

The goal of the present research was to further investigate very young children's understanding and use of symbols. Specifically, the study investigated whether experience with relational mapping in one task influenced performance in a very different symbolic task.

The training on relational correspondence seemed to have no impact on children's performance on the symbolic task that required relational mapping. Both groups encoded the location of the original toy (Memory Retrieval), yet failed to use that information to make an inference about the location of the other toy (Symbolic Retrieval). Thus, the training on relational correspondence experienced by the children in the Transfer Group was ineffective in increasing their sensitivity to and use of relational correspondence in the symbolic task.

One important contribution of this study is that it replicated the previous findings reported by Marzolf (1996). More importantly, these similar results were obtained with different materials and spaces, as well as with a different geographical population. Thus, 3-year-old children's difficulty with using relational correspondence in the model task appears to be quite general.

The group data indicated that, contrary to the original hypothesis, transfer between the training tasks and model task did not occur (Transfer Group). Because there was a large amount of variability in children's performance on the training task and the model task, individual scores were examined across tasks. Surprisingly, there was no significant relation between performance on the matching task and performance on the model task. Success on the matching task (>9 points) was not at all correlated with success on the model task (3 or 4 correct Symbolic Retrievals). Five children succeeded on the matching task, yet only one was subsequently successful on the model task. Conversely, of the seven children who did not succeed on the matching task, two were successful on the model task. The relation between performance on the matching task and the model reconstruction component of the model task was equally ambiguous. Similarly, there was no significant correlation between children's performance on the model reconstruction and Symbolic Retrieval components of the model task. Thus, the group and individual data strongly indicate that appreciation of relational correspondence in the training task had little impact on relational mapping in the task.

There are a number of possible explanations for the absence of the predicted transfer effect. One is that the training task did not help the children, because the two tasks were too dissimilar. In the task described earlier, in which relational mapping in a picture task supported relational mapping in the more difficult method task (Marzolf, 1996), the two tasks were highly similar. Both were object retrieval tasks conducted in the same space. Perhaps this contextual support is necessary for transfer to occur. This possibility suggests certain directions for future research. For example, one might make the training task more similar to the model task by using two sets of miniature furniture rather than abstract colored blocks. In this way, children may be more likely to see the two sets as similar, which might facilitate transfer.

Another potential explanation for the lack of transfer is that the training task was too difficult. Children were immediately correct on only 62% of their block placement. In the face of such difficulty, children may have lost motivation for the subsequent tasks. Indeed, many of the children in the Transfer Group seemed frustrated during the training session. This lack of motivation may be reflected in the fact that the children in the Transfer Group performed poorly on the placement trial of the model task (33%) compared to the children in the Control Group (67%). Perhaps in the future, training tasks that are better at holding children's attention could be used. For example, instead of using a sparse grid in the matching task, one might use a colorful drawing of a farm yard with a number of identical fenced areas. The experimenter would place different toy animals in the various pens, and ask the child to place his or her animals in the same way.

In spite of the observations indicating a lack of motivation, there are at least two pieces of evidence that suggest that loss of motivation is an unlikely explanation of children's poor performance on the model task. First, the children who were successful on the training task, and presumably remained motivated, performed no better on the model task than did children who had difficulty with the training task. Second, all children performed well on the Memory Retrieval component of the model task. This would be

unlikely if children were generally unmotivated to participate. Instead, they seemed to be involved in the task, yet had difficulty with using relational correspondence as a basis for mapping between the spaces. Thus, it seems unlikely that children's poor performance was due to lack of motivation, uncooperatively, or boredom.

From a theoretical perspective, the absence of transfer between the training task and the model task is interesting. Indeed, this is one of the few times in which transfer has not been used using this paradigm (Marzolf & DeLoache, 1994; Marzolf, Pacha, & DeLoache, 1996). Thus, transfer as a mechanism of symbolic development does appear to have its limits. Future research that examines various dimensions of task similarity, such as contexts and demand characteristics, should provide us with a better understanding of the limits of transfer.

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Figure Captions

Figure 1. Depiction of the matching task for the Transfer Group.

Figure 2. Depiction of the drawing task for the Transfer Group.

Figure 3. The model and room arrangement used in the model task.

Figure 4. The results of the model task, showing the performance of both groups as a function of retrieval.

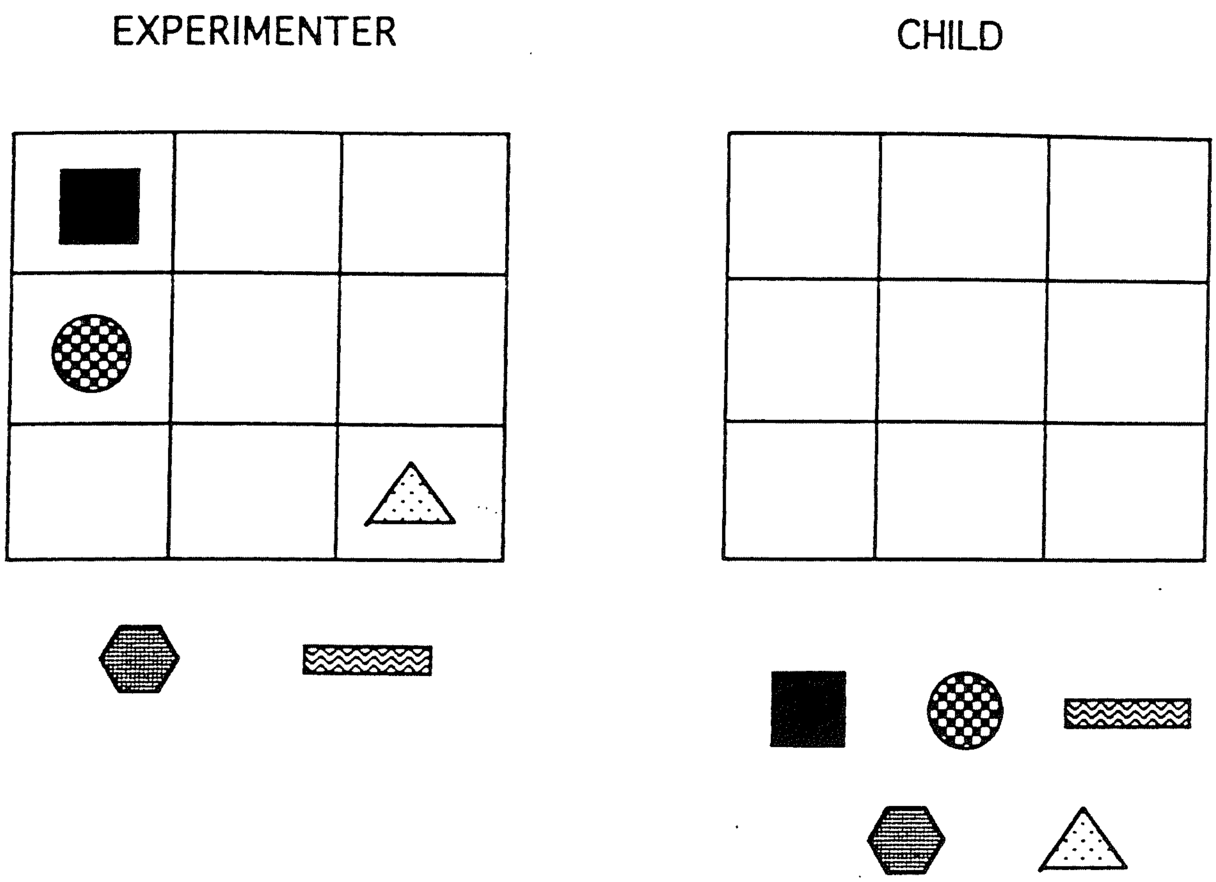

Figure 1.

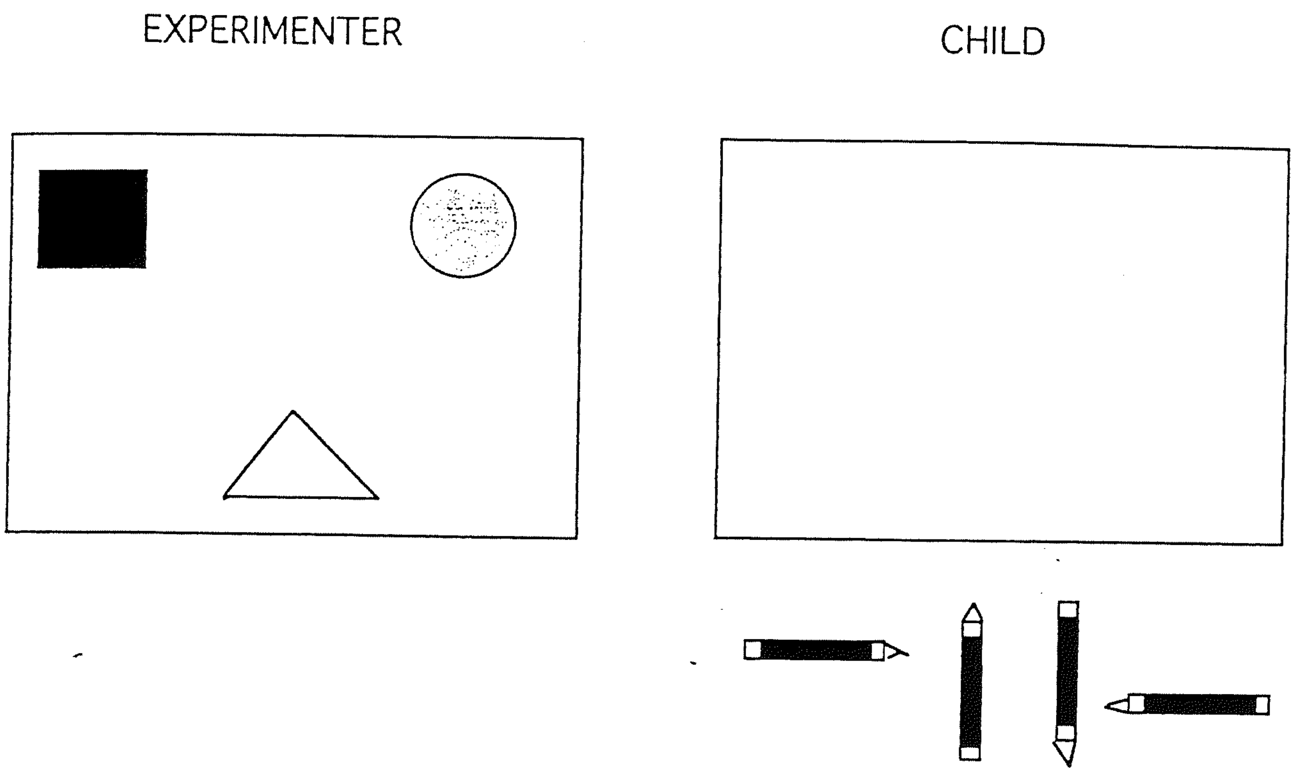

Figure 2.

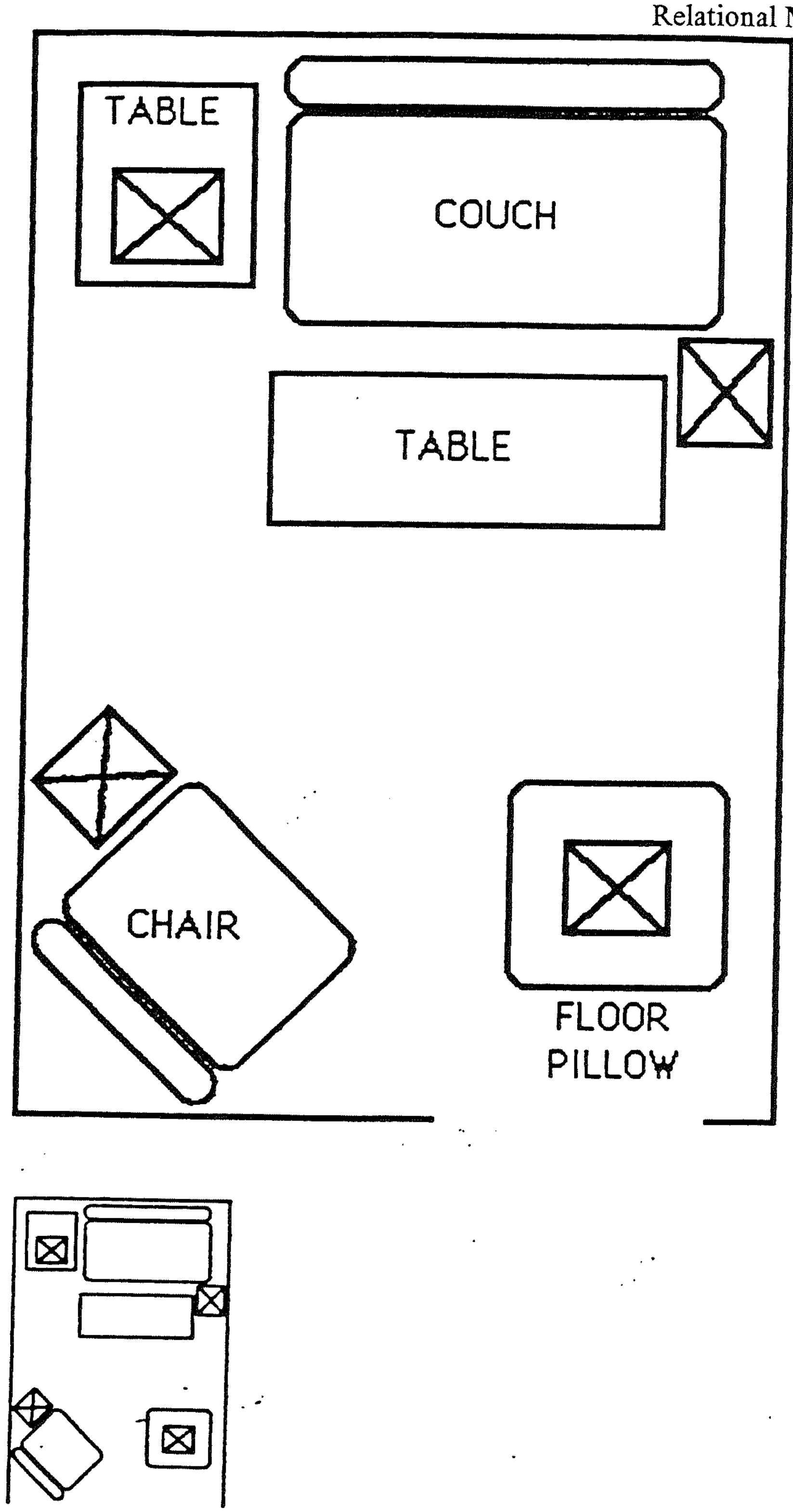

Figure 3.

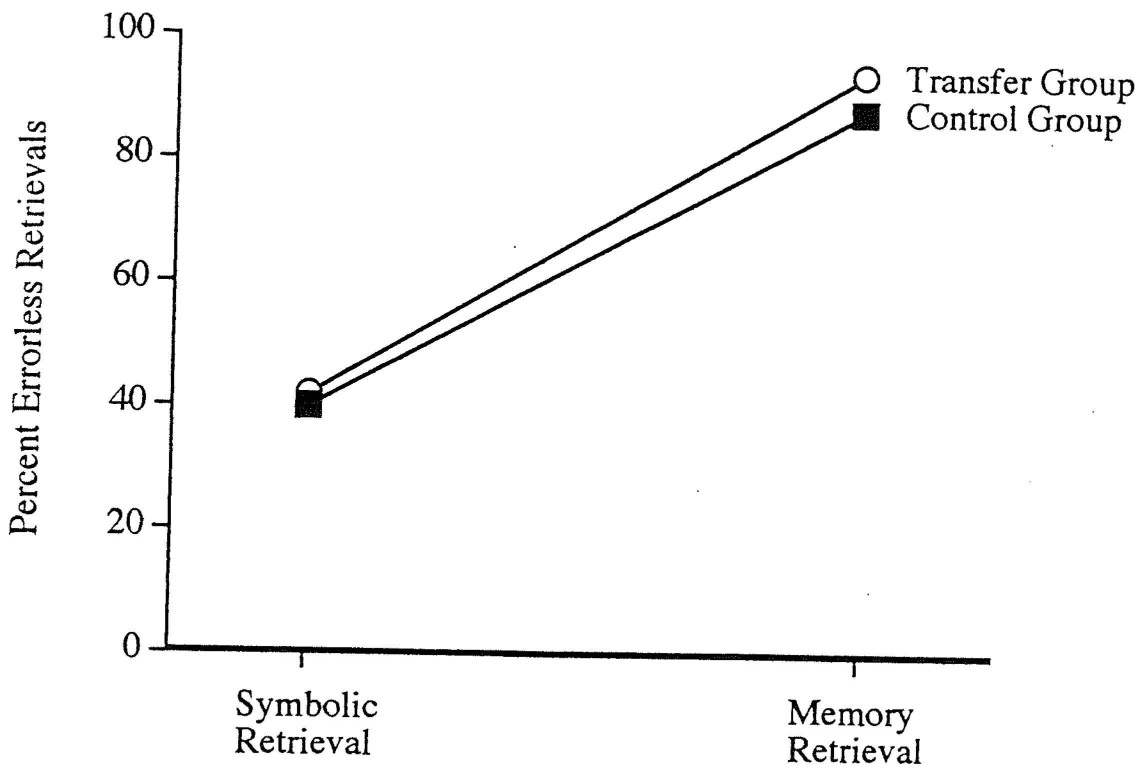
100
80
60
40
20
0
Percent Errorless Retrievals
Transfer Group
Control Group
Symbolic Retrieval
Memory Retrieval

Figure 4.