1976

The effects of pictures and spatial array on two-year olds' memory for location.

Hilary Anne Horn
University of Massachusetts Amherst

THE EFFECTS OF PICTURES AND SPATIAL ARRAY ON TWO-YEAR OLDS' MEMORY FOR LOCATION

A Thesis Presented

by

Hilary Anne Horn

Submitted to the Graduate School of the
University of Massachusetts in partial
fulfillment of the requirements for the degree of

MASTER OF SCIENCE

April, 1976

PSYCHOLOGY

THE EFFECTS OF PICTURES AND SPATIAL ARRAY ON TWO-YEAR OLDS' MEMORY FOR LOCATION

A Thesis

By

Hilary Anne Horn

Approved as to style and content by:

Nancy A. Myers, Chairperson of Committee

Marvin Daehler, Member

Thomas Roeper, Member

Jerome L. Myers, Chairman
Department of Psychology

April, 1976

Table of Contents

List of Illustrations

Abstract

Twenty-four month old children were presented a delayed response task in which memory for the location of a hidden object was assessed. Location was either relevant or irrelevant in finding the object, pictures presented with the hidden object were labeled or unlabeled, and the spatial arrangement of the boxes containing the hidden object were the same or different when the object was hidden and found. It was hypothesized that labeling the pictures and changing the array might reduce reliance on location cues and increase reliance on pictorial cues. Labeling was found to produce effective utilization of pictorial cues when the array was the same and location was irrelevant, but changing the array did not facilitate performance. Two-year old children, then, did not seem to spontaneously utilize verbal labels or pictorial cues, but are capable of doing so if the label is provided.

Introduction

Relatively little is known concerning memory processes in children between the ages of one and three undoubtedly due in part to difficulties in testing children this young. Memory for location of a hidden object and the differential utilization of specific cues for finding the object can provide useful information in the study of very young children's cognitive processes. Localization tasks are typically conducted using a delayed response paradigm in which the child is shown the location of an object and is prevented from initiating search for a predetermined period of time. Because children as young as nine months can respond adequately in this task (Evans and Gratch, 1972; Gratch and Landers, 1971), and children's performance is not perfect until age four or five, age differences in the representational processes which mediate finding the object can be investigated. Ideally, then, this task can provide both specific information concerning memory for location and be suggestive of memory processing in general.

Hunter (1913, 1917) first employed the delayed response paradigm in attempting to characterize the memory capacity of animals and young children. In these early studies, the primary questions investigated were whether a delay had an effect on recall and if it did, how long a delay could be imposed. Length of delays and resulting errors were recorded for each animal and child tested, and it was found that when a delay occurred, recall was decremented and performance declined as the delay occurred. Because no overt means of finding the object were detected for children, such as maintaining body orientation toward the hidden object during the delay, a system of cues associated with finding

the object were inferred to be internally maintained and capable of initiating responding. Hunter described this process as being an "intra-organic kinesthetic factor." We would now define this process as memory and refer to such cues as mediators, but the recognition that some internal process existed was a valuable one.

More recent studies of location have attempted to investigate developmental changes in the utilization of spatial and visual cues involved in finding the hidden object. Babska (1965) theorized that the child's search for the object could be directed either by the location alone or by visual information associated with the location. Remembering a color, size, or pictorial cue linked to the location would seem to be a more effective strategy for recall than having to rely solely on spatial cues to locate the object. She tested children ranging in age from eighteen months to five years in a four choice task. The child was shown one box which had a picture, geometric form, or color as a cover. After a toy was hidden in this particular box, it disappeared from the child's view for a short delay period. The child was then given three new boxes each with a different cover from the same set of visual stimuli in addition to the baited box and was told to find the hidden toy. The percentage of correct responses increased from relatively poor performance by the youngest children to almost perfect performance by the five year olds. The largest increase came between the ages of two-and-a-half and three-and-a-half, and experimental variations such as labeling the forms on the covers or varying the number of trials given had little effect below and above these ages. While Babska did not discuss the specific results of the experimental manipulations, which

were not incorporated into the main experiment, she concluded that there is a shift between these ages from primary reliance on the memory of spatial cues to that of visual cues in directing search which accounted for the young child's poor performance.

Though Babska stated that young children relied more on place cues than visual cues in directing search, appropriate place cues were not available for the child to utilize in this task. To support this claim then, younger and older children's performance must be compared when relevant location cues and visual information are included in the task. If young children can rely on place cues, but do not utilize pictorial cues, then their performance should be good when only location is a relevant cue and performance would not be further facilitated when visual information is added. Older children's performance, however, should improve when the pictorial cues are present. Loughlin and Daehler (1973), using a task similar to Hunter's, compared the performances of children aged 27, 32, and 42 months when pictures were and were not paired with the location of the hidden object. Four boxes were presented to the children both when the object was hidden and found. In this case, the position of the baited box alone could be used to locate the object. The oldest children made more correct responses when the picture cues were present, but children under 42 months of age performed no differently whether they were present or absent. The younger children did perform above chance level in the task which indicated that they could effectively utilize spatial cues; however, they were clearly not using the pictorial information to improve recall of the hidden object's location. These findings, then, support Babska's observations of a marked improvement

between the ages of three and three-and-a-half in locating a hidden object by means of visual cues.

The Loughlin and Daehler study evaluated the use of added discriminative cues by pairing them with the location of hidden objects, and found that search by children under three was not benefited by these cues. This procedure may, however, underestimate young children's use of these cues because the association between picture and location is arbitrarily determined by the experimenter, and may not be defined as relevant by the child. The child may be capable of using visual information if the cues are not merely arbitrarily assigned, but appear intrinsically relevant to the location of the object. Thus, the child's deficiency may lie in defining the relevancy of an association between picture and location rather than a basic inability to encode and retrieve visual information. Daehler, Bukatko, Benson, and Myers (1976) varied the size and color of the box in which the object was hidden in a four choice task with children aged 18, 24, 30, and 36 months. Three different sets of boxes were used: one set consisted of containers all the same color and size; in another set each container was the same size but a different color; in the third set each was the same color but a different size. At every age the additional discriminative cues of size and color did improve performance. Additional discriminative cues defining the location of the hidden object, then, can be facilitating even to children under age three, and apparently it is the young child's failure to associate arbitrary cues with location which accounts for the lack of improvements in his performance when the arbitrary cues are present.

In addition to using boxes of varying physical dimensions, two trials were presented at the end of the experiment in which place and

discriminative cues were in conflict. During the delay period of these conflict trials, the boxes were surreptitiously relocated so that the hidden object could be found only on the basis of the color or size of the baited box rather than its location. Few of the subjects under the age of three used the size and color cues during the conflict trials and most initiated search on the basis of the location cues. Half of the thirty-six month olds were able to successfully locate the object using the size, but not the color cues. Thus, young children were capable of using cues defining the object's location at least when redundant with place cues, but did not search solely on the basis of any discriminative cues after a series of redundant cue trials. Children over three years of age, however, did use at least one type of additional visual information to initiate search.

Because the failure to utilize pictorial cues reported by Loughlin and Daehler (1973) seemed to be a product of not associating them with the location of the hidden object rather than an inability to profit from the added information, Blair, Perlmutter, Horn, and Myers (1976) conducted an experiment in which the effects of labeling the pictures was examined. The younger child may need to be provided labels to link a pictorial cue with the location of the hidden object. If verbal mediation is necessary for utilization of pictures and the two year old is less likely to produce his own labels than the three year old, then the younger child should use the pictorial cues to mediate his recall when labels are provided for him. Children aged 27, 33, and 45 months were given a nine choice task in which pictures associated with the baited box were present or absent. Another condition was added, however, in which pictures were also labeled so that location, pictorial, and

verbal cues were presented. Contrary to previous findings, the performance of children at all ages was facilitated by the presence of picture cues and adding verbal cues improved performance still further. The results did suggest that labeling was effective in producing the association between location and picture, but were discrepant with previous findings that pictures alone did not increase correct responding for children under age three. The authors suggested that because the children received all three cue conditions, providing labels on some trials induced them to produce and utilize their own labels on other trials in which pictures, but no labels were provided. The child's labels produced during trials when only pictures were present would explain the facilitative effect not previously found, and suggests that if labels are produced by the child, the picture is associated with the hidden object and is used to mediate recall.

The studies discussed indicate that at specific ages and under certain conditions young children will use discriminative cues to aid their search. In these studies, however, children have usually been required to find the hidden object when location was a consistent cue for search and discriminative cues were redundant with location. While encoding of visual cues by young children seems evident, perhaps this information is only useful in conjunction with location. The findings of Daehler, et. al. (1976) indicated that only older children did use size cues alone to direct search. Stronger evidence for a shift from reliance on place to visual cues would be obtained if older children could locate the hidden object on the basis of pictorial cues alone and performance decreased when pictures were present but irrelevant in finding

the object. Daehler, et. al. (1976) did attempt to determine the importance of visual versus place cues by using the conflict trials, but using two conflict trials after twelve test trials in which location was always an appropriate cue was perhaps too stringent a test. Presenting a task in which all test trials were conflict trials would provide a more sensitive measure of young children's use of visual information. Horn and Myers (1976) presented children aged 24 and 36 months with one of four cue conditions in a nine choice task. Two conditions presented in Loughlin and Daehler (1973) and Blair, et. al. (1976) were replicated: pictures were either present or absent, so that only location was a relevant cue, or both pictures and location were relevant and redundant. In the remaining conditions one of the cues was relevant and the other irrelevant. When pictures were relevant and location irrelevant, the box containing the hidden object was surreptitiously repositioned during the delay period so that finding it was contingent upon recalling under which picture the object was hidden. When location was relevant and pictures irrelevant, the picture identifying the baited box was switched with another picture present in the array. In this case, reliance on location was necessary to find the object but reliance on the picture should reduce correct responding.

In accordance with Loughlin and Daehler (1973), performance was not significantly improved when pictures were redundant with location for either 24 or 36 month olds; but, when one cue was relevant and the other irrelevant, very dramatic age differences in performance occurred. When pictures alone were the only appropriate cues for search, the three year olds performed as well as they did when location cues alone were present. Their performance, however, dropped to chance level when the picture

associated with the hidden object was changed making location the only relevant cue for search. Location cues, easily used by children of these ages when no other conflicting cues were present, were not utilized effectively in the presence of conflicting picture cues. For the two year olds the pattern of correct responding was much different. When the pictures were the only appropriate cue to finding the object, their performance dropped to chance level unless they spontaneously labeled the pictures in which case they performed as the three year olds did. Unlike the three year olds, however, when the pictures were present but irrelevant, two year olds performed as well as they did when only location cues were present or when picture and location cues were redundant. Clearly the three year old child can encode and direct his search using pictorial information, while the two year old relies primarily on location cues to find the object. The younger child can use visual information when a label is provided or if the discriminative cues are less arbitrary and more intrinsic parts of the object's location.

When pictorial information was the only relevant cue in locating the hidden object, two year olds performed quite poorly which indicated they were not using the pictorial cue. As has been shown before, however, the non-utilization of visual information is not necessarily an inability to use the cues, but rather may be an inability to recognize the relevancy of the pictures. The finding that pictures are used more effectively when labels are provided suggests that labeling may emphasize visual cues, and thus encourage the association between picture and object. On the other hand, reliance on location has been demonstrated to be the primary strategy of younger children in the previous research in which the containers always remained in the same array. De-emphasizing

location cues by rearranging the spatial array may therefore also encourage younger children to make the association between picture and hidden object.

The purpose of the present investigation, then, is to evaluate the effects on two year olds' performance when the spatial arrangement of the containers is changed and the pictures are labeled. The two conditions described by Horn and Myers (1976) in which pictures were paired with the hidden object and were redundant with location and the pictures were present and were the only relevant cues will be replicated with both labeled and non-labeled stimuli. In all four of these conditions the same three by three array will be used when hiding and finding the object. For two additional conditions the stimuli will again either be labeled or not labeled, but a three by three array will be provided when the object is hidden, and a horizontal nine by one array will be presented for search. It is expected that the children in each of the labeling conditions will perform better than their non-labeling counterparts. Further, when location is a relevant cue and the same array is presented when hiding and finding the object, correct responding should be greatest. When location is irrelevant, the task should be more difficult than when location is relevant, but presenting a different spatial array should facilitate performance in comparison to having the same array presented. The prediction of order in correct responding from lowest to highest, then, is Non-labeled Same Array-Irrelevant Location < Labeled Same Array-Irrelevant Location ≤ Non-labeled Displaced Array-Irrelevant Location < Labeled Displaced Array-Irrelevant Location ≤ Non-labeled Same Array-Relevant Location < Labeled Same Array-Relevant Location. Although a shift may occur in primary reliance from place to

visual cues, two year olds may be able to use the more effective visual information.

Method

Subjects. Eight boys and eight girls at a mean age of 24 months and 20 days were tested in each of six experimental conditions. All subjects resided in the greater Springfield, Massachusetts area and were tested at the University of Massachusetts Child Study Center located there. Three girls and one boy failed to complete the experiment and were replaced.

Apparatus and materials. The apparatus consisted of twenty-two plywood platforms onto which nine plastic containers were fastened into either three by three or nine by one arrays, and two copies of ninety-nine picture cards. On each of the three practice and eight test trials, nine different laminated cards of simple line drawings in color, representing objects easily recognized by two-year olds, were placed atop the boxes so that the same pictures appeared in both arrays. The platforms were placed on a child size table at which both subject and experimenter were seated. Taped to the right side of the table was a paper bag in which the child could place small crackers, used as the hidden objects, after finding them. Behind this small table a divider was placed to screen both the unused arrays and a tape recorder operable by remote control which emitted a series of tones twenty-five seconds apart. Directly behind the child's seat at the stimulus array there was a similar child size table and chair which held an attractive toy to be used during the delay.

Procedure. After becoming acquainted with the experimenter, each child and one or both parents were escorted to a nearby experimental room. The

child was seated at the table with the stimulus array while the parent sat to the left of the child. Three condition-specific practice trials were given to the child to aid his understanding of the task. On the first two trials the cracker was hidden by the experimenter and the procedure which took place during the delay period of the test trials was shown to him. No delay period was imposed on these trials so that the child was allowed to search immediately. On the third trial the delay of twenty-five seconds was imposed as in the test trials. The child saw the cracker hidden, went across the room to play with the distracting toy, and returned to search for the object after the delay. He was allowed to search in two positions and if he did not find the cracker, its location was shown to him by the experimenter.

The experimental condition to which each subject was assigned determined whether location was relevant or irrelevant, whether the stimuli were labeled or non-labeled and which arrays were presented. These conditions are illustrated in Figure 1 and are described below in greater detail. Each of the conditions was conducted with both labeled and non-labeled pictures. When the experimenter hid the cracker in all conditions in which labeled pictures were used she said, "I'm hiding the cracker with the (name of the picture)," while pointing to the picture. When the child found the cracker or it was shown to him by the experimenter, the experimenter said, "The cracker was hidden with the (name of the picture)," and again pointed to the picture. When non-labeled pictures were used, the experimenter said, "I'm hiding the cracker," while pointing to the picture. After searching ended, she said, "The cracker was hidden here," and again pointed to the picture.

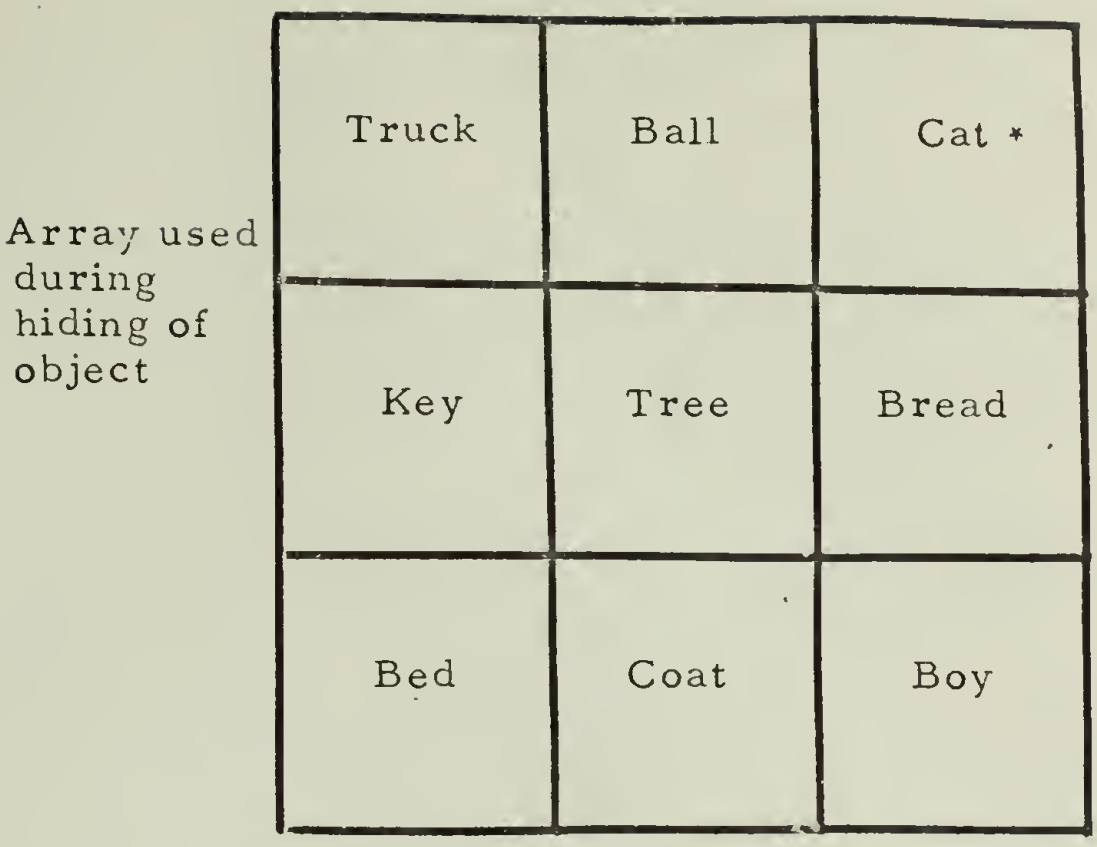

Figure 1. Schematic drawing of apparatus for each condition type

In the Same Array-Relevant Location conditions, the same three by three array was presented when the object was hidden and found, and the cracker remained in the location originally shown the child.

In the Same Array-Irrelevant Location conditions, the same three by three array was again used at hiding and finding, but the cracker and its associated picture were repositioned during the delay period.

In the Displaced Array-Irrelevant Location conditions, the cracker was hidden in the three by three array. During the delay period, the cracker was placed in a nine by one array displaying the same pictures. The nine by one array was then available to the child after the delay to initiate search.

Eight trials were given in which the object was hidden once in each position of the array excluding the central space. In all conditions four random orders of final positions were generated and utilized for two boys and two girls. In the Irrelevant Location conditions, the initial hiding positions were randomly paired with final positions and were not adjacent to them. The pictures were randomly arranged on each trial with the constraint that one picture was designated as the test picture. The test picture always corresponded to the position which was designated as the final position of the object. When location was irrelevant, the test picture was placed over the initial position of the object and then moved with it to the appropriate final position.

Results

The mean percentage of correct responses, errorless trials, and error responses were examined. Correct responses were the total number of correct choices out of a possible two responses on each trial. Errorless trials included only those trials in which first responses were correct. Thus, if the child was incorrect on his first choice but was correct on his second choice, then the score for the trial would be one correct for correct responses, but zero for errorless trials. Error responses were the total number of errors made.

In the main the analyses of these measures yielded essentially parallel findings. A discussion of each, however, will be presented. Analyses of variance were carried out to examine the effects of labeling, condition type, sex, order of presentation, and trial blocks. The latter was analyzed with both four and two trials in each block. No significant effects were obtained for sex, order, or two- or four-trial-blocks nor were any interactions observed between these and the other variables for any dependent measure except for a Block x Condition x Sex interaction for error responses.

Mean percentage of correct responses

Figure 2 and Table 1 show the mean percentage of correct responses as a function of condition type and labeling. When the array remained the same during the hiding and finding of the object and the original location remained a relevant cue (Same Array-Relevant Location), correct responding was greatest, but when original location became irrelevant,

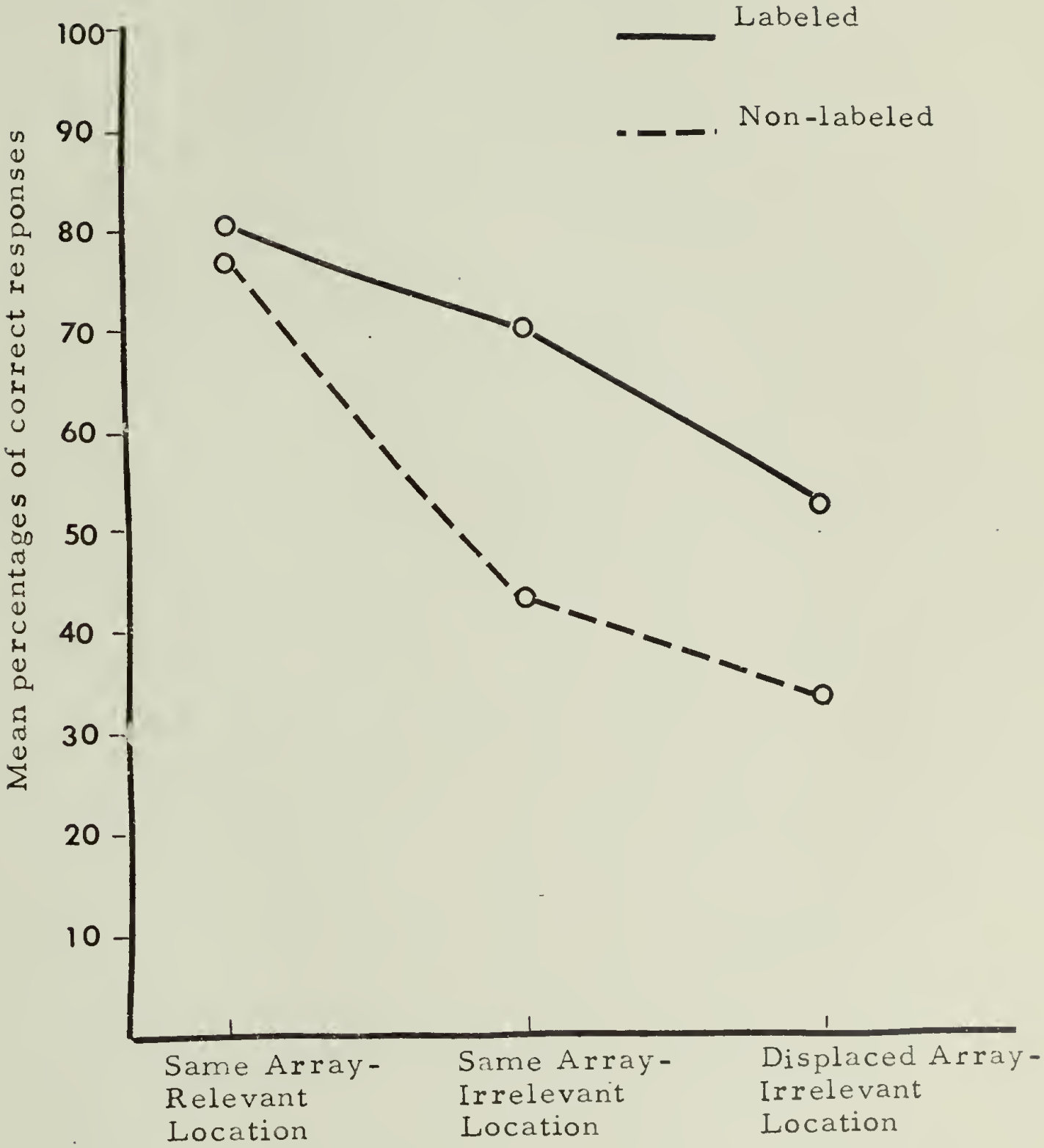

Figure 2. Mean percentages of correct responses as a function of labeling and condition type

Table 1

Mean Percentages of Correct Responses

	Condition Type			
	Same Array-Relevant Location	Same Array-Irrelevant Location	Displaced Array-Irrelevant Location	Combined Over Condition Type
Labeled	80.5	70.3	53.1	68.0
Non-labeled	77.3	42.2	33.6	51.0
Combined over Labeling	78.9	56.3	43.4	

performance decreased (Same Array-Irrelevant Location). Performance dropped even further when the array was changed in addition to making the original location irrelevant (Displaced Array-Irrelevant Location). Differential effects of condition type were supported by a significant Condition Type main effect ($F(2,48) = 25.78$, $p < .001$). Labeling the picture associated with the hidden object also improved performance and a significant main effect of Labeling was observed ($F(1,48) = 17.11$, $p < .001$). The effects of labeling did vary, however, among the three condition types which resulted in a significant Labeling x Condition Type interaction ($F(2,48) = 3.21$, $p < .05$).

Bonferoni t-tests were carried out to compare differences in performance between Condition Types and between the six labeling and condition type combinations. Performance within the Same Array-Relevant Location condition was significantly better than in the Same Array-Irrelevant Location and Displaced Array-Irrelevant Location groups (EW's $< .10$); however, the two irrelevant location conditions decreased reliably in relation to that of the Same Array-Relevant Location condition; but when no labeling occurred, performance dropped significantly for both irrelevant condition types, which did not differ from each other. Further, for each label-nonlabel comparison within each condition type, correct responding differed for only the Same Array-Irrelevant Location groups. Performance was significantly poorer when non-labeled pictures were presented than when the pictures were labeled (EW $< .10$). Performance in all six labeling and condition type groups was significantly above chance level (p's $< .05$).

Mean percentage of errorless trials

Table 2 shows the mean percentage of errorless trials as a function of condition type and labeling. In accordance with the mean percentage of correct responses, performance was highest in the Same Array-Relevant Location condition type, decreased in the Same Array-Irrelevant Location condition type and was poorest in the Displaced Array-Irrelevant Location condition type. Differential effects of condition type were supported by a significant Condition Type main effect ($F(2,48) = 22.05$, $p < .001$). Labeling the picture associated with the hidden object also improved performance as compared to not labeling it and a significant main effect of Labeling was observed ($F(1,48) = 13.01$, $p < .001$). The effects of labeling did vary among the three condition types, but in contrast to the previous findings, resulted in only a marginally significant Labeling x Condition Type interaction ($F(2,48) = 3.08$, $p < .10$).

Bonferoni *t*-tests were carried out to compare differences in performance between condition types and between the six labeling and condition type combinations. As with the mean percentage of correct responses, performance within the Same Array-Relevant Location condition type was found to be significantly superior to that of both the Same Array-Irrelevant Location and Displaced Array-Irrelevant Location groups (EW's < .10), which did not differ from one another. As before when no labeling occurred, performance in the Same Array-Relevant Location condition differed significantly from both irrelevant location groups (EW's < .10), which did not differ from one another. In contrast to the previous findings, however, when the appropriate picture was

Table 2

Mean percentages of errorless trials

	Condition Type			
	Same Array-Relevant Location	Same Array-Irrelevant Location	Displaced Array-Irrelevant Location	Combined Over Condition Type
Labeled	66.4	57.8	38.3	54.2
Non-labeled	64.8	28.9	19.5	37.8
Combined over Labeling	65.6	43.4	28.9	

labeled there were no differences in performance across condition types, nor were there any differences for any label-nonlabel comparison within each condition type. Performance was significantly above chance level for all labeling and condition type groups (p's < .05) except for the two nonlabeled irrelevant location conditions.

Mean percentage of error responses

Table 3 shows the mean percentage of error responses as a function of condition type and labeling. In accordance with the previous two dependent measures, there were fewest errors made in the Same Array-Relevant Location condition type, errors increased in the Same Array-Irrelevant Location condition type, and further increased in the Displaced Array-Irrelevant Location condition. Differential effects of condition type were supported by a significant Condition Type main effect ($F(2,48) = 23.89$, $p < .001$). Labeling the picture associated with the hidden object also decreased the number of errors committed as compared to not labeling it and a significant main effect of Labeling was observed ($F(1,48) =$ $p < .001$). As when the mean percentage of correct responses was used as the dependent measure, a significant Labeling x Condition Type interaction was found ($F(1,48) = 3.61$, $p < .05$).

Bonferoni t-tests were carried out to compare differences in performance between condition types and between the six labeling and condition type combinations. As before when no labeling occurred, performance in the Same Array-Relevant Location condition was superior to that of both the irrelevant location groups (EW's < .10), which did not differ from one another. When the target pictures were labeled, however, there were no differences in performance across Condition Types which corres-

Table 3

Mean Percentages of Error Responses

	Condition Type			
	Same Array-Relevant Location	Same Array-Irrelevant Location	Displaced Array-Irrelevant Location	Combined Over Condition Type
Labeled	26.7	35.3	52.3	38.1
Non-labeled	29.1	64.6	74.4	56.1
Combined over Labeling	27.9	50.0	63.4	

ponded to the findings using the mean percentage of correct responses. For each label-nonlabel comparison within each condition type, the only difference in performance observed was between the Same Array-Irrelevant Location conditions. Fewer errors were made in this condition type when the pictures were labeled as opposed to when they were not (EW < .10). This finding corresponded to that observed when the mean percentage of correct responses was used as the dependent measure but not with the mean percentage of errorless trials. Performance was significantly above chance level for all six labeling and condition type groups (*p*'s < .05).

Error Analyses

The percentage of the target items that were spontaneously labeled was examined; however, this rate of labeling was only 11.6% varying between 7.8% and 15.6% regardless of whether pictures were labeled or not by the experimenter. Further analyses were conducted to determine if there was a tendency to return to the location correct on the preceding trial; however, the percentage of errors made of this type did not differ from chance level for any labeling and condition type combination. In addition, there was no tendency observed to choose any particular position more often than expected by chance. One particular type of error did occur significantly more often than expected by chance. Forty-seven percent of the errors made by those children in the Non-labeled Same Array-Irrelevant Location condition and thirty-five percent of the errors in the Labeled Same Array-Irrelevant Location condition consisted of choosing the original

location of the hidden object on that trial ($t(15) = 3.44$, $p < .01$; $t(15) = 3.30$, $p < .01$).

Discussion

Very young children demonstrated quite competent memory performance in locating a hidden object associated with a particular picture. Overall, both leaving the object in its initial location and labeling the appropriate picture increased correct responding; however, in different condition combinations, the utilization of cues varied. When the same array was presented during the hiding and finding of the object and location remained a relevant cue throughout the task, performance was best and labeling had little effect. The two-year old child seems to easily encode and rely on location cues to direct his search, but he does not utilize the additional labeling cue to further aid his memory. This finding seems to contradict the results of Blair, Perlmutter, Horn, and Myers (1976) who found that 27 month olds did profit from labeling cues; however, those children were three months older and a within-subjects design was used in that study, which may account for the discrepancy. When the arrays differed in the task and location was thus an irrelevant cue, labeling did not aid performance either. Interference from the setting itself seemed to disrupt performance so much that the presence of labeling was not facilitating. Possible sources of this interference will be discussed later.

Labeling the pictures did lead to significant differences in performance, however, when the array remained the same throughout the task and the original location of the hidden object was an inappropriate cue in finding it. Only the picture associated with the object was useful here in directing the child's search. When the picture was

labeled in this Same Array-Irrelevant Location condition, correct responding was nearly as great as when both the picture and the object's original location were relevant memory cues. When the target picture was not labeled, however, performance dropped significantly in relation to the Same Array-Relevant Location conditions. Moreover, a significant proportion of the errors committed by both Same Array-Irrelevant Location groups consisted of choosing the location where the object was originally hidden on each trial. Clearly when the picture is not labeled and location is irrelevant, the two-year old child relies on the location cue which he defines as relevant. Further, even when labeling is present and thus results in more efficient utilization of the pictorial cue, the child continues to encode and utilize location information some of the time. It is interesting that this type of error did not occur significantly more often by chance in the Horn and Myers (1976) study when all eight trials were considered, even though the population sampled was the same and a procedure similar to the nonlabeled Same Array-Irrelevant Location condition in this study was used. This type of error was committed at above chance level in that study, however, for the first two trials but decreased significantly across trials. Apparently the children learned that the response to the initial position of the object was inappropriate.

The systematic encoding and utilization of location cues by two-year old children seems quite evident in that performance is good when location is a sufficient cue on which to base their memory, performance decreases when success in the task requires that they ignore location

information, and their errors are consistently based upon the encoding of irrelevant location cues both when they can and cannot utilize pictorial information efficiently. Even though the two-year old child relies spontaneously on location cues, he is able to make use of verbal labels when location is irrelevant. Labeling may provide emphasis on visual cues and encourages the encoding of the association between the object and the picture which the child does not seem to ordinarily make himself. Alternately, the child may encode only the verbal label and use it to match its visual counterpart in the array. Daehler and Bukatko (1976, in preparation) have found that the child is quite competent in verbal-visual matching and does so even more efficiently than visual-visual matching. In either case, the child's difficulty seems to lie in not spontaneously labeling the picture cues. When the pictures were not labeled for him, he labeled only sporadically himself and did not repeat the label any more frequently when it was presented to him. It is possible that the child labeled the pictures covertly; however, past research indicates that such activity probably occurs in much older children (Flavell, 1970; Hagen and Kingsley, 1968), and that overt naming precedes covert labeling (Appel, Cooper, McCarrell, Sims-Knight, Yussen, and Flavell, 1972). Thus, it would not be expected that these two-year olds were silently labeling the pictures when they were not overtly naming. Spontaneous labeling, then, is a strategy in which the two-year old child does not seem to typically engage, even though he is capable of utilizing the label once it is provided. The development in utilizing pictorial cues seems to lie not in the ability

to make the association between the hidden object and its picture or matching a label to the picture, but rather in spontaneously producing the label which provides the association or make the match possible.

In this task, it has been shown that the two-year old child represents and utilizes certain kinds of information. These kinds of information may be thought of in terms of Bruner's (1966) theory of cognitive growth through varying modes of representation. He discusses three types of representation: enactive which is action based; iconic which is imaginal in nature; and symbolic, a system composed of remote and arbitrary features which can signify abstract relations, i.e. language. The predominant nature of the child's representation is presumed to advance through stages corresponding to these types of representation. Thus, the infant relies on enactive representation, the preschooler on images, and the older child on language. The data shown here might be viewed as somewhat contradictory to Bruner's notions in that the verbal label is utilized efficiently by very young children. If it is assumed that the function of the label is to provide a link between the picture and the hidden object, then symbolic information functions conceptually at a much earlier age than Bruner's model might predict. This investigation, however, in no way tests his theory because it is not at all clear what is being represented by the child or how the label facilitates performance in the task. Further, a verbal label is not representative of the complexities present in a symbolic language system nor does its beneficial effect necessarily indicate that symbolic representation is primary at age two.

While labeling did provide emphasis on visual cues and facilitated performance under certain conditions, displacing the array clearly did not improve performance. In contrast to the predicted facilitative effects, correct responding was lowest in these conditions, though not significantly more so than in the Same Array-Irrelevant Location conditions. Even labeling the pictures did not compensate for the influence of this condition on performance since the level of accurate responding did not differ between the labeled and nonlabeled groups. Apparently unexpected interfering factors specific to that condition type were present. One possible explanation for the difficulties experienced by the children may lie in the presentation of the two different arrays during the task. The arrays may have provided important contextual cues for the subjects in this task. Because the arrays were different, the children may have regarded each as representing a separate problem having little connection between them. For success, not only must the child associate the picture with the hidden object in each array, he must also define the two arrays as being related to one another. Labeling the picture may have aided him in making the first association, but not the second. If the child did not define the arrays as comprising the same task, poor performance would be expected. Campione and Brown (1974) have demonstrated considerable contextual effects of this sort and have shown that the younger the child, the more likely it is that information stored tends to be influenced by the way in which it is originally presented and encoded. Utilizing information in memory may depend upon whether all of the components present during encoding the information are present at

retrieval. Further, the amount of overlap between the elements associated with encoding and retrieval provides a definition of the similarity between the two settings. If the pictorial or verbal cues were encoded in conjunction with the specific array, then changing the array during the retrieval situation may have resulted in the two settings being defined as comprising different tasks.

A second possible reason for the poor performance in this condition may be that the array itself was too expansive to be conducive to exhaustive search. The horizontal arrangement required fairly systematic searching in order to locate the target picture. The two-year old may not be planful enough in his search to find the picture even if the hidden object was associated with it when labeled, it was remembered, and the necessary connection between the two arrays was made. Thus deficiencies in systematic complete search may have interfered with the utilization of the pictorial cue in the displaced array. It is unlikely that such response difficulties would be present only when the array was displaced. In the other conditions, however, the child always searched for the hidden object in the 3x3 array which occupied a more compact space. The likelihood of the child's glance falling upon the target picture, then, would be greater when searching in the 3x3 array than in the horizontal 9x1 array, even if he were searching unsystematically in both cases. Thus, the spatial organization of the two arrays may have contributed to the success or lack of it in finding the hidden object.

Both of these speculations as to the reasons for failure of the displaced array to facilitate performance may be tested in future

research. Understanding the lack of facilitation from this condition would not only clarify the findings of this investigation, but also would be suggestive of the nature of young children's search strategies and contextual definitions. To differentiate between the accuracy of the two hypotheses the object could be hidden in the 9x1 array and searched for in the 3x3 array. If the child's difficulty lies in treating the two arrays as separate problems, his performance should be the same as in the present Displaced Array-Irrelevant Location condition. If, however, his poor performance is a result of the interaction between his searching strategies and the horizontal arrangement of the boxes, then his performance should equal that of the Same Array-Irrelevant Location condition since the child would be searching in the 3x3 array in both cases. Inefficient searching strategies may be examined by having the child look at each picture before he makes his choice, thus forcing systematic exhaustive search. If performance is improved by this technique, it may be assumed that nonsystematic incomplete searching patterns limit performance of the very young child.

In summary then, two-year old children remember the location of a hidden object very well if the object's original position is the same as its final position, but additional verbal cues do not provide further facilitation in this case. When the child must rely solely on cues other than position, such as pictures, he does not spontaneously use them and continues to utilize the inappropriate location cues. When the picture cue is labeled for him and the object's original location is not a useful cue in finding it, the child can then locate the object efficiently. While the two-year old child does not seem to spontaneously

produce verbal cues or utilize pictorial information, he is capable of doing so if the label is provided. This label seems either to encourage the association between the hidden object and the pictorial cue or to allow him to match the label with the appropriate picture.

References

Appel, L., Cooper, R., McCarrell, N., Sims-Knight,J., Yussen, S., and Flavell, J. The development of the distinction between perceiving and memorizing. Child Development, 43, 1365-1381.

Babska, Z. The formation of the conception of identity of visual characteristics of objects seen successively. In P.H. Mussen (Ed.) European research in cognitive development. Monographs of the Society for Research in Child Development, 1965, 30 (Serial No. 100), 112-124.

Blair, R., Perlmutter, M., Horn, H., and Myers, N. The effects of visual and verbal cues in very young children's memory for location of hidden objects. Unpublished manuscript. University of Massachusetts, 1976.

Bruner, J.S., Olver, R., and Greenfield, P. Studies in cognitive growth. New York: John Wiley & Sons, 1966, 1-68.

Campione, J. and Brown, A. The effects of contextural changes and degree of component mastery on transfer of training. In H.W. Reese (Ed.) Advances in Child Development and Behavior, Vol. 9. Academic Press: New York, 1974, pp. 70-111.

Daehler, M. and Bukatko, D. Visual-visual and visual-verbal matching in very young children. In preparation, University of Massachusetts, 1976.

Daehler, M., Bukatko, D., Benson, K., and Myers, N. The effects of size and color cues on the delayed response of very young children. Bulletin of the Psychonomic Society, 1976, Vol. 7, 65-68.

Evans, W. and Gratch, G. The stage IV error in Piaget's theory of object concept development: Difficulties in object conceptualization or spatial localization? Child Development, 1972, 43, 682-688.

Flavell, J.H. Developmental studies of mediated memory. Reese & Lipsett, Eds. Advances in child development and behavior, Vol. 5. New York: Academic Press, 1970, 181-211.

Gratch, G. and Landers, W. Stage IV of Piaget's theory of infants' object concepts: A longitudinal study. Child Development. 1971, 42, 359-372.

Horn, H. and Myers, N. The effects of picture cues in very young children's memory for location. Unpublished manuscript. University of Massachusetts, 1976.

Hunter, W.S. The delayed reaction in animals and children. Behavior Monographs, 1913, 2 (Whole No. 1).

Loughlin, K.A. and Daehler, M. The effects of distraction and added perceptual cues on the delayed reaction of very young children. Child Development, 1973, 44, 384-388.