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ABSTRACT

Forty boys and forty girls from kindergarten through fourth grade placed dolls with mobile heads in front of, behind and beside themselves, and in front of, behind and beside another doll to demonstrate development of spatial concepts. The heads and bodies of both dolls were either in convergent or divergent alignment or some combination. Placements were highly consistent within and across children with respect to the location of the doll versus the child's own body or the other doll. Generally, placements were made on the basis of the body rather than the face cue except where use of the face would not violate the body's priority. Girls, and older girls in particular, evidenced greater sensitivity to the face cue than did boys. [Filmed from best available copy.] (Author/MK)

The Role of Face and Body Cues in Children's Judgments of Front, Back, and Side[1]

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Errata to "The Role of Face and Body Cues in Children's Judgments of Front, Back, and Side" (Harris & Strommen)

Please make the following corrections in this paper:

p. 4, lines 16-18 should read:
"...and, for one placement, told him to put the other doll in front of the first doll, for another placement, behind the first doll, and for still another placement, beside the first doll."

p. 5, lines 9-11 should read:
"...and, for one placement, told him to put the doll in front of himself, for another placement, behind himself, and for still another placement, beside himself."

p. 11, lines 13-16.
The percentages should read: Pattern Z: 60.7%; Pattern W: 13.9%; Pattern X: 9.7%; Irregular: 15.7%.

p. 12, line 6 should read:
"...were relatively less consistent in their use of this pattern..."

p. 12, lines 16-17 should read:
"So Pattern Z, both in terms of frequency of use and, by the stricter criterion, individual consistency of use, was overwhelmingly the preferred pattern."

p. 22, line 5 should read:
"...Pattern Z were not."

bottom of p. 36 and top of p. 37 should read:
"...24-week-old infant girls showed significantly greater 'interest fixations' to pictures of human faces than did infant boys."

INTRODUCTION

This is the second in a series of studies on the development of the spatial concepts 'front', 'back', and 'side'. Research on these concepts has been virtually neglected, in sharp contrast to the numerous investigations of left and right. This state of affairs perhaps is occasioned by the general belief that front and back are cognitively 'primitive', or simple, concepts that even the preschooler has mastered in all their few subtleties while more cognitively complicated spatial dimensions such as left-right are not mastered until much later. Such a belief is understandable if the child's knowledge of front-back is assessed, as is typically done, simply by asking him to identify the front, back, and sides of objects having identifiable front-back features, such as his own body. This sort of test is passed very easily, probably since most parents give their children so much practice in learning the names of body parts. At least this would be true in the case of "back" for which the spatial location bears the same name as the body part. This correspondence does not exist for "front". Parents instead teach "tummy" or "stomach", reserving the term "front" for articles of clothing. In this instance, then, children learn "front" through practice in putting on shirts or pants in the correct front-to-back orientation.

Our own thinking, based now on a good deal of preliminary data (Harris & Strommen, in press), is that such 'mastery' of front-back as the typical preschool-or kindergarten-age child shows, represents only the first of many stages of acquisition of what is in fact an extremely subtle and multifaceted concept. Our objective has been to disclose

the various elements of the front-back concept and to map out experimentally the course by which these elements are learned by normal children by looking at how children make 'in front', 'in back', and also 'beside' placements of ordinary objects.

Our work thus far has been concerned with the role played by the presence or absence of front-back features, so in our first study, we had compared front, back, and beside placements of objects lacking distinguishing front-back features, such as cubes and drinking glasses, with placements of featured objects like dolls, little cars, and other toys. In the present study, we used only one type of object -- dolls -- and we now are concerned with the potentially different role of face and body cues.

Our expectation is that across age, face cues will replace body cues as the basis for placement inasmuch as older children should be more sensitive to the special social meaning of face contact. Possibly, girls will showh such sensitivity more than boys in view of research which indicates that girls are more interested in people, [illegible] personal relationships, than are boys (Goodenough, 1957).

We have other informal reasons for expecting that face and body may play different roles because when we have asked children, Where's your front?, and Where's your back?, nearly all immediately designated their abdomens and chests, and then their backs. But when we asked them how they could tell their front from their back, some children mentioned face cues, others, body cues.

Because the objects in our previous study did not permit independent manipulation of the alignment of face and body cues, generalizations

about the potentially different roles of these cues in making front-back judgments could not be made. There are several questions here: most basically, does the face define the front of the body, or does the body? How would children place one doll "in front of", "in back of", and "beside" another doll when either the face of the placed doll or the face of the referent doll is turned to the side?

METHOD

Subjects.

A total of 40 girls and 40 boys were tested. They ranged in age from 5.05 yrs (5 yrs, 19 days) to 10.21 yrs. (boys: $\bar{X}$ = 6.80 yrs., girls: $\bar{X}$ = 6.91 yrs.). The ages were distributed as follows: 5-6 yrs: 13 boys, 14 girls; 6-7 yrs.: 15 boys, 12 girls; 7-8 yrs.: 3 boys, 0 girls; 8-10 yrs.: 9 boys, 14 girls. All the children were enrolled in grades kindergarten, first grade, and a combined third and fourth grade in a public school in East Lansing, Michigan at the time of testing. The school is located on the Michigan State University campus, and the great majority of children are from student families. All the children who participated would be characterized as middle-class as measured by parents' educational level.

Materials.

Each child made a series of 'in front', 'in back', and 'beside' placements of a pair of dolls with mobile heads. The dolls were the 'Ken' and 'Barbie' dolls. 'Ken' is 12 & 1/2 in. in height, while 'Barbie' is an inch (half a head) shorter. Both dolls were provided with 2-in. diameter clear plastic platforms which enabled them to stand alone and with their hands at their sides.

Procedure.

Each child was tested individually in a spare room in the school. The child sat on a blanket on the floor, and the dolls were placed on an 18-in square white poster board positioned in front of him and flush against a plain wall. The intent was that no other objects would be in the child's immediate field of view. The experimenter sat slightly behind and to the child's left throughout the session.

At the outset of testing, the experimenter showed the child a bag filled with 10-cent prizes and told him to pick a prize for taking part in the task. The prize then was set aside until the task was completed. The intent here was to make clear to the child that his prize was not dependent on his performance.

Each child made two kinds of placement: "object-referent" and "self-referent".

1. Object-referent. For the object-referent condition, the experimenter placed one of the dolls in front of the child and, on one trial told him to place the other doll in front of the first doll, on another trial behind the first doll, and on still another trial beside the first doll. (We shall call the doll placed by the child the "placed doll", and the other doll the "referent doll".) The actual instructions, recited from memory, were as follows: "I want to see whether you know where to put things. See this doll? [the experimenter showed the child one of the dolls.] Do you know what his (her) name is? [Nearly all the children were familiar with the Ken and Barbie dolls.] I'm going to put Ken (Barbie) on the board, right here [placing the doll in the direct center of the board.] Now, I'm going

to give you Barbie (Ken) to put on the board. You can put her (him) anywhere on the board that you like -- here [indicating the side closest to the child], or here, or here [etc., indicating, with sweeping movements of the hand, all areas of the board], wherever you think is the right place. OK, here's Barbie (Ken); put her (him) in front (behind, beside) Ken (Barbie)." In the object-referent condition the referent doll was always set a constant distance from the child.

2. Self-referent. For the self-referent condition, the experimenter gave the child Ken or Barbie and, on one trial, told him to place the doll in front of himself, on another trial behind himself, and on still another trial, beside himself. The actual instructions differed from those in the object-referent condition only as required by the change in the condition. Two additional poster boards were used, one behind the child, another on his right side.

Out of the child's line of vision, the experimenter recorded the child's placements onto a response sheet so designed as to represent both location and orientation of his placements. By "location" we mean, in the case of the object-referent trials, where on the board the child put the placed doll; in the case of the self-referent trials, on which of the three boards the placement was made. By "orientation" we mean how, relative to the referent doll on the object-referent trials, and relative to his own body on the self-referent trials, the child oriented the ventral side of the body of the placed doll. Thus, one placement could differ from another in location, orientation, or both.

In both the self-referent and object-referent conditions, after every placement the experimenter removed the placed doll without commenting on the child's placement.

As in our previous study we had to be able to conclude that any systematic patterns of placement were not merely a consequence of the method of presenting the dolls. For example, it had seemed possible to us that a child might place an object in the same orientation as it was given him. We therefore followed our previous procedure: on at least half the trials for each child, the experimenter routinely presented the doll in such an orientation as to require the child to re-orient it before placing it. As we had found before, no child failed to re-orient the doll under these circumstances before making his placement.

Manipulation of head and body cues.

The major experimental variable was the combination of alignments of the head and body of the dolls.

Object-referent condition. There were three different combinations used for the referent doll in the object-referent condition. The first is illustrated in Fig. 1, no. 1. This is a schematic representation of

Fig. 1 about here

the referent doll with the outer circle indicating the body and the inner circle indicating the head. The open sides of the circles indicate the front of the body and the face. In the first combination, head and body are aligned convergently. The child is represented as facing the doll.

Nos. 5 and 9 show the second and third combinations. In these, the head is turned -- as shown from the child's perspective -- to the right and left of the body, respectively.

Each of these three combinations was presented in four different orientations relative to the child - with the body toward the child (nos. 1, 5, and 9), 180 degrees away (nos. 2, 6, and 10), turned to the child's right (nos. 3, 7, and 11), and to the child's left (nos. 4, 8, and 12).

Note that nos. 5 & 9, 6 & 10, 7 & 11, and 8 & 12 constitute four pairs of trials on which the body orientation of the referent doll was the same but the heads were turned in opposite directions. These pairs will be discussed later in connection with certain analyses of the placements.

Each of these 12 variations constituted a single trial on which the child made three placements (front, back, and beside) with the placed doll, for a total of 36 placements.

For individual children, the combination of alignments of head and body for the 'placed' doll was the same for all 12 trials. Half the boys and girls placed a doll whose head and body were in congruent alignment. (In Table 1, these 40 children are represented in Cols. 1 and 2). For the remaining children, the head and body of the placed doll were in divergent alignment (Cols. 3 and 4 in Table 1). For somewhat less than 3/5ths of the children, the placed doll's head pointed to the right (the same as the referent doll shown in Fig. 1, no. 5), while for the remaining children the placed doll's head pointed to the left (Fig. 1, no. 9). Short of doubling the number of subjects, it was not possible to systematically counterbalance the direction of divergent head alignment across all other variables.

Self-referent condition. In the self-referent condition, each child made three placements (front, back, and beside) with a doll whose head and body were in each of the three alignment combinations (= nine placements total).

Since on the object-referent trials, every child's placed doll remained in either convergent or divergent head-body alignment throughout all 12 object-referent trials, the consequence of the design on the self-referent trials was that a group of subjects could not be defined all of whose placements on both self-referent and object-referent trials involved either all convergent alignment or all divergent alignment.

The final design consisted of total counterbalancing across the following variables: 1. order of presentation of the object-referent and self-referent conditions; 2. designation of Ken or Barbie as the doll to be the placed doll; 3. sex of subject. The six possible orders of presentation of 'front', 'back', and 'beside' instructions were systematically assigned across each subject's 12 object-referent and three self-referent trials. In the self-referent trials a similar procedure was used to assign the six different orders of presentation of the three combinations of head-body alignment of the placed doll. Finally, in the object-referent condition, 12 of the most different orderings of the 12 variations shown in Fig. 1 were systematically assigned across subjects. In all these latter instances, assignments of orders were made so as to approximate complete counterbalancing.

For purposes of the major planned analyses, each of the eight groups of subjects as defined by the variables head-body alignment of placed doll in object-referent trials, sex of child, and testing order,

was divided into two equal groups of younger and older children on the basis of the median split for that particular group. Therefore, within each group, the average ages of the younger and older children were slightly different, ranging from 6 yrs, 1 month to 6 yrs. 7 months.

Since preliminary examination of scores of children assigned 'Ken' and children assigned 'Barbie' failed to disclose any differences, this variable was not included in the formal analyses.

RESULTS & DISCUSSION

Like our earlier work, the results were extremely complex in view of the many different ways the children could -- and did -- make their placements. But we had already clearly identified major systems or patterns in our prior study, so now we could raise the question, would the availability of face and body cues as separate bases for placements result in patterns like those found before, or would new patterns appear?

It proved to be the case that the most frequently occurring patterns could be best and most simply described in terms of the body orientation of the dolls, since these patterns recurred regardless of the head orientation in relation to the body of the doll. Implicit in this statement is our general finding that body cues were the predominant basis for placement, although there were occasions when face cues were used. Until such time as we discuss those occasions, we shall describe the patterns of placement in terms only of the orientation of the bodies of the dolls. We shall refer to the front side of the body as the ventral side, the back side as the dorsal side. When, later, we discuss the face cues, we shall refer to the 'face' side.

Object-Referent Trials

Regular patterns. Fig 2 depicts the three most common placement

Fig. 2 about here

patterns used by the children on the object-referent trials. As in our previous study, we found that the location of the placed doll was the same --- on the ventral side of the referent doll for the 'in front' instruction, on the dorsal side for the 'in back' instruction, and on either of the two remaining sides for the 'beside instruction. The drawings indicate the more frequent location for beside' placements.

Thus, to place 'in front' means to locate on the ventral side, and whether that side is turned toward or away from or to one side of the child's own body is unimportant.

What differentiates the patterns is the orientation of the ventral side of the placed doll. In Pattern W, the ventral side is toward the referent doll for the front and back placements but is the same as the orientation of the ventral side of the referent doll for the beside placement; in Pattern X, the ventral side is toward the referent doll in all instances; in Pattern Z, the child matched the ventral orientation of the placed doll to the ventral orientation of the referent doll in all instances.

Two of these three patterns (X and Z) are the same as we found in the object-referent trials with featured objects in our previous study. The third pattern in that study (named Pattern Y) was one in which the child made all three placements so that the sides of the placed object faced the referent object. This pattern was used primarily with small

wheeled toys that we surmised were the kinds of toys that children ordinarily would grasp by the sides and then would push laterally. Pattern Y did not appear as a major pattern in the current study undoubtedly because the only objects used were dolls which we suspect are less likely to be played with consistently in this way. Instead they would seem to be objects that childr[illegible]en play with in a face-to-face manner. Patterns like Y did oc[illegible]r in the current study but only infrequently and therefore have been inc[illegible] amo[illegible] the 'irregular' patterns to be discussed later.

The total percentages of use of each of thes[illegible] patte[illegible]ns are listed in Col. 5 of Table 1.

Table 1 about here

As in our first study the predominant pattern was Pattern Z. Over the 960 total three-placement trials by the children, 60.1% were in this pattern. Pattern W accounted for 13.7%, and Pattern X for 9.7%. All patterns not matching one of these three are termed "irregular" patterns. Irregular patterns accounted for 17.0% of the placements.

Consistency of use of patterns within individual subjects. One of the salient findings in our first study was the consistency with which individual children used the same patterns across trials. Similarly strong consistency appears in the current investigation. Table 2 lists the number of children using the same placement pattern on at least eight

Table 2 about here

of the 12 three-placement object-referent trials. Sixty-three of the

80 children were consistent according to this criterion. Of these children, 79.4% (50 of 63) used Pattern Z. Of the remaining 17 consistent children, six used Pattern X (9.5%), and seven children used Pattern W (11.1%).

The scores also suggest that the 50 children who, by this criterion, were consistent in use of Pattern Z, were relatively more consistent in their use of this pattern than were children who were consistent in their use of Patterns X and W. As we reported earlier, over the study as a whole, Pattern Z accounted for 60.1% of the total number of placements (Table 1, Col. 5), yet 79.4% of the subjects used Pattern Z. In contrast, users of Patterns X and W were in about the same proportion as the incidence of the Patterns experiment-wide.

With a stricter criterion of consistency of use, namely, use of the same pattern on all 12 trials, 24 of the 80 children proved to be consistent. Of these, 22, or 91.7%, used Pattern Z. So Pattern Z, both in terms of frequency of use, and individual consistency of use was overwhelmingly the preferred pattern.

Interpretation of regular patterns.

Why this predominance of Pattern Z? We cannot be sure, but we wonder whether it is because this is the way children see many things lined up. Examples might be groups of people seated in an auditorium, cars in traffic, children queud up to go to the playground, cans on a grocer's shelf, all the different situations in which people or things are lined up. Pattern Z also constitutes the most symmetrical arrangment of the dolls, and there is evidence for the importance of symmetry as a stimulus variable from a variety of tasks, such as tasks requiring judgment of the uprightness of non-representational geometric forms (e.g., Harris & Schaller, 1971; Schaller & Harris, 1971), or studies of preference for and recognition of forms (e.g., Paraskevopoulos, 1968).

Patterns W and X can be seen as variants of Pattern Z also reflecting frequently occurring locations of bodies though for the front placements these can be seen as locations for social interation. For most kinds of social interaction, people stand with their bodies oriented toward each other rather than front to back. In fact a few children spontaneously remarked, upon making their front placements, that the dolls could see or talk with each other. Pattern X appears to express this theme in the beside placement as well.

This interpretation suggests that we might find a greater use of Patterns W and X by the older children and by the girls, but no such differences were apparent. We shall be interested in such comparisons at numerous points in our analyses.

We must make very clear that this interpretation of the difference between Patterns W and X and Pattern Z does not mean that use of face cues had played a more important role as a spatial cue in Patterns W and X. All three patterns, so far as we can tell, are based equally on the body orientation of the dolls and not on the orientation of the face. In other words, the bodies of the dolls serve as the spatial basis for the placements in each pattern. We can illustrate this point if we consider Pattern X when the faces and bodies of both the placed and referent doll are in divergent alignment: in this case, though the bodies of the dolls, for the front placement, would be turned toward each other, the faces would be looking either away from each other or in the same direction but in any case not toward each other. As we have already pointed out, the consistency scores indicated that the great majority of children used the same pattern across the majority of object referent trials. The children therefore had to

ignore the faces were turned in order to use the same patterns, ., to make their placements in the same locations and with the bodies in the same orientations.

Implicit in this example is the distinction we wish to make between the use of face or body as spatial cues and their use as social cues. Our suggestion is that when two bodies are turned toward each other, as in Patterns W and X, social interaction is possible regardless of whether the faces at that moment are facing each other or turned away, and a child wishing to express this potential interaction would use this pattern across the various combinations of head-body alignments of the dolls. One of the children, mentioned above, who had explained her use of Pattern X by reference to the possibility of social interaction was asked how this was possible inasmuch as the dolls' faces were turned away from each other. She matter-of-factly replied, "They're just looking away for a minute."

We do not mean to imply, however, that the use of the face as a spatial cue disallows its simultaneous use as a social cue; the distinction is a conceptual one which in the case of the regular patterns clearly makes an empirical difference. When we discuss the irregular patterns, we will see that in some instances, the apparent intent to express the possibility of social interaction is manifested through the use of the face as the basis for placement (See Fig. 3, Pattern 2) just as in the examples just cited, this intention was manifested through the use of body cues.

Frequency of use of patterns as function of alignment of dolls. Table 1 also lists the percentages of occurrence of the characteristic placements according to the combination of convergent and divergent head-body alignments of the placed doll and the referent doll (as shown in Fig. 1). The distribution of the total percentages listed in Col. 5 is paralleled by the distributions of percentages for each of the combinations in Cols. 1-4. The implication is that the tendency to use a pattern reflecting social interaction was not affected by variations in head-body alignment of the dolls. Had there been such a tendency, the distribution of percentages of use of the various patterns would have been markedly different from one column to another.

Irregular Patterns.

Let us now consider the irregular patterns -- those that differ from either Pattern W,X, or Z. We believe that a large proportion of these irregular patterns are different from the regular patterns in ways that can be explained most easily as the result of conflicts between face and body as spatial cues, and that these conflicts seem to have been resolved either in favor of face cues or in favor of some combination of face and body cues.

Of the 960 object-referent trials, irregular patterns were used on 150 trials. Of these, 77 different irregular patterns could be distinguished. There were no sex or age differences in the distribution of use of the patterns. Fig. 3 shows six patterns which illustrate the major kinds of differences.

Fig. 3 about here

They are listed in order of increasing discrepancy from the regular patterns.

In the first kind (No. 1), patterns differed only in the orientation of the face of the placed doll; in the second (No. 2), patterns differed in the location of the placed doll, though a regular location was still used; in the third (No. 3), the dolls were oriented diagonally in a regular location; in the fourth (No. 4), the dolls were located on the diagonal but in a regular orientation; in the fifth (No. 5), the dolls were oriented and located diagonally. Further, each deviation might have occurred either for only one placement within a pattern of three placements, or for more than one placement, or there might have been a combination of any of the above named kinds of deviation (e.g., No. 6).

As might be evident from these examples, making judgments of the use of face as a spatial cue in such patterns involves some degree of inference, but we feel fairly confident about the majority of cases.[3] For example, in Pattern No. 2, the locations of all three placements seem to have been determined by the orientation of the head of the referent doll. Indeed, if we were to categorize this pattern on the basis of face rather than body cues, we would recognize it as Pattern W in Fig. 2. In Pattern No. 6, the location of the front placement appears to be in response only to the orientation of the face of the referent doll, while the locations and orientations of the beside and behind placements appear to be attempts to effect a compromise between face and body cues. The same seems true in Pattern No. 5 for the location and orientation of the front placement. In Pattern No. 1,

however, we are unable to see how face cues could have influenced the irregular beside placement, and we have no other explanation for such a pattern. We found strong evidence for the use of face cues in 80 of the 150 trials, and a clear absence of evidence in 29 trials. The remaining 41 trials were unclear.

We can see also, in Table 1, that, unlike the regular patterns, the distribution of use of irregular patterns did change with changes in the combination of alignments of the dolls -- from 6.9 percent when the head and body of both the placed doll and referent doll were in convergent alignment (Col. 1) to 24 percent when the head and body of both dolls were in divergent alingment (Col. 4). Cols. 2 and 3 list the percentages for those trials for each group of children on which the head and body of one doll were convergent and for the other doll were divergent. The results indicate that as the amount of cue-divergence increased, i.e., as we go from Col. 1 to Col. 4, the frequency of use of an irregular placement pattern increased. Apparently too, head-body divergence in the placed doll (Col. 3) had more impact psychologically than head-body divergence in the referent doll (Col. 2).

The incidence (in percent) of use of the various kinds of irregular patterns described above, as a function of the particular combination of convergent and divergent head-body alignments of the two dolls, is shown in Table 3. (Note that the column headings are the same as in Table 1.) We already have noted the increase in the frequency

Table 3 about here

of use of irregular patterns as the amount of cue-divergence increased (from Col. 1 to Col. 4). We now can see that the distribution of kinds of irregular patterns changed as well. For example, no irregularities involving use of a diagonal location or of a diagonal orientation ever occurred when the head and body of both dolls were in convergent alignment. In fact, these kinds of irregularities were quite rare irrespective of cue complexity. The effects of cue complexity on irregularities can be seen most clearly on irregular patterns not involving the use of diagonal locations or orientations. If we compare the group for whom the head and body of the placed doll were always in convergent alignment (Cols. 1 and 2) with the group for whom they were in divergent alignment (Cols. 3 and 4), we see that the percentage use of irregular patterns was more than double in the latter group.

Use of face as cue as measured by location shifts of beside placements.

Let us now consider some other instances when the use of the face as a spatial cue and also as a social cue becomes apparent. Recall that each subject had four pairs of trials, spaced throughout the total of 12 trials, on which the body orientation of the referent doll was the same but the heads were turned in opposite directions (nos. 5 and 9, 6 and 10, 7 and 11, and 8 and 12, as shown in Fig. 1). It was on these trials that the role played by face cues was easiest to see. In Fig. 4, an example based on the pair 5 and 9 is shown. In the top part,

Fig. 4 about here

which illustrates the use of the face cue, a change in the orientation of the head of the referent doll is accompanied by a change in the location of placement of the placed doll. In the bottom part, which illustrates the absence of such use, the location of the placed doll remains constant irrespective of changes in orientation of the head of the referent doll. It is only these 'beside' placements that are significant here -- the front and back placements are the same in all instances. This particular illustration shows Pattern Z. This 'switching' occurred in all other patterns too, and under both convergent and divergent alignments of head and body of the placed doll.

Note that if the children had made their front or behind placements so as to have the face of the referent doll look at the placed doll, they would have had to reject the body as the basis for placement. The beside placement, however, lets the child use the face cue in addition -- and in such a way as to not reject the body's priority.

We should mention that the base level of switching on the beside placements should not be presumed to be 50% but instead was substantially lower. In our previous study, right-side 'beside' placements, when both the placed object and referent object lacked distinct front-back features, were three and one-half times more frequent than were left-side placements. This large difference was undoubtedly related to the higher incidence of right-handedness in the sample. As we suggested then, the right side would be the more convenient side for right-handed children insofar as a right-side placement would not require these children to cross over the referent object. In the current study 71 of the 80 subjects were right-handed. Therefore, the significance of the shift in location of the placed doll in response to the change in

orientation of the head of the referent doll must be weighed against the strong tendency to place objects on the side of the preferred hand. Trials on which the body of the referent doll was turned to the side require 'beside' placements on the near and far sides of the doll. Here, then, the significance of the shift in location of the placed doll must be weighed against the tendency to put the placed doll on the near side of the referent doll. The results of our earlier study (this time on those trials with featured objects) indicated that the tendency to make beside placements on the near side was substantially stronger for both left- and right-handed children.

The incidence of location shifting is shown in Table 4. The

Table 4 about here

subjects' scores are listed separately by sex and age of subject, and according to whether the head-body alignment of the placed doll was convergent or divergent. Within each sex X alignment-of-placed-doll cell, the younger and older groups were defined by splitting the group at the median C.A. as described earlier.

In the interest of having a large-enough number of trials to permit stable estimates of these effects, we have combined testing orders in Table 3. Our examinations of the data suggest that we are not consequently doing any violence to our interpretation of the results.

The most outstanding features of this table are the greater frequency of location-change in girls ($\bar{X}$ = 1.53 changes made in the four pairs of trials) than in boys ($\bar{X}$ = 0.95) and in older ($\bar{X}$ = 1.48) than in younger children ($\bar{X}$ = 1.00). An analysis of variance of these

change scores, with age and sex of child and head-body alignment of the placed doll as the 'between' -subject variables, disclosed that the sex effect was significant ($F = 4.60$, $df = 1/72$; $p < .05$), while the age effect was significant at only $p < .10$ ($F = 3.14$, $df = 1/72$). No other main effects or interactions were significant.[4]

There is also the suggestion, clearer from inspection of individual children's scores than from the group averages listed in Table 4, of a sex by age interaction in addition to the sex and age main effects. Therefore, for each of the four sex by alignment-of-placed-doll groups,we computed Pearson correlation coefficients for the relation between the children's ages in days and their number of location shifts on the four paired trials. The correlations were significant for both girls' groups (convergent alingment: $r = .44$, $n = 20$, $p < .025$; divergent alignment: $r = .36$, $n = 20$, $p < .05$) but were non-significant for both boys' groups (convergent alignment: $r = .17$, $n = 20$; divergent alignment: $r = .02$, $n = 20$).

With the addition of these analyses, we now can conclude that on these beside placements, the girls were not only more responsive to the fface cues than were the boys, but that only for the girls was there a relation between age and incidence of shift.[5]

<u>Incidence of location-shifting according to placement pattern</u>. The use of the location shift on the beside placements as an indicator of sensitivity to the face suggests a means of checking an hypothesis about the difference between Pattern Z and Patterns W and X. Recall that for the front placements in Patterns W and X, the two dolls were oriented with their bodies toward each other whereas in Pattern Z they

were front to back (see Fig. 2). The former orientation, we suggested, was more characteristic of social interaction. We wondered, then, whether children using Patterns W and X consistently were thereby expressing a social relationship between dolls that children using Pattern X were not. To check this possibility, we looked to see whether children using Patterns W or X consistently (eight or more uses in the 12 trials) also made relatively more location shifts on the beside placements than did children using Pattern Z consistently. Unfortunately for this hypothesis, there was no evidence of any difference by this measure. There, if, and in whatever manner, the front placements for Patterns W and X express a social relationship between the dolls, it does not appear to be related to the sensitivity to the face expressed by location shifting of beside placements.

Self-Referent Trials

Regular Patterns.

In the self-referent condition, with the exception of one child, all the placements were completely uniform as respects the location of front, back, and beside. That is, 79 of the 80 children made their placements in the appropriate location in relation to their own bodies.

The single exception, a 5 & 1/2-yr.-old kindergarten girl, made her in back and beside placements and two of the three in front placements appropriately but made the third in front placement in the beside location. On this trial, the doll's head and body were in convergent alignment, and each placement was made with the doll facing the child.

The 80 children in our previous study, who ranged in age from 4:9 to 7 & 1/2 yrs., all made their placements in the appropriate location. The present study therefore corroborates these results.

Like our previous study, variations in placement, when they occurred, occurred in how the child turned the doll on each of his three placements, i.e., in whether, when he placed a doll, he oriented it with its face toward himself, away, or to one side. Again, as in our previous study, we were able to distinguish three major types of patterns. These three correspond to Patterns W, X, and Z of the object-referent trials (see Fig. 2) except that the child takes the place of the referent doll.

Once again, the same two patterns (X and Z) that we found in the object-referent trials of both the current and our previous study, we now find in both studies on the self-referent trials. And once again, the third pattern in the previous study was Pattern Y, used with small wheeled toys, which the children placed so that the sides of the objects faced their own bodies.

Our surmise as before is that Pattern Y did not appear as a major pattern on the self-referent trials of the current study because the only objects used were dolls. As on the object-referent trials, patterns like Y did occur but infrequently and therefore have been included among the irregular patterns.

The percentages of use of Patterns W, X, and Z and of the irregular patterns are shown in Table 5. The percentages are tabulated separately

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Table 5 about here

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for the younger and older boys and girls for each of the three combinations of head-body alignment of the doll, and according to whether these self-referent placements preceded or followed the object-referent placements. Together, the three patterns accounted for about 69 percent of the total number of placements. (Patterns X, Y, and Z in our previous study accounted for about 75 percent of the total number of placements.) Of the regular patterns, X and Z were predominant, though slightly more irregular patterns occurred than did either of these. Pattern W occurred roughly only a third as often as did any of the others.

Relative incidence of use of regular patterns on self-referent trials and object-referent trials.

Though the major patterns therefore are the same on both these self-referent trials and the object-referent trials, we see that the relative incidence of their use is very different. On the object-referent trials, Pattern Z was by far the most frequently used (60 percent of the total), whereas on the self-referent trials (see Table 5) its relative incidence of use dropped to less than 30 percent, while the use of Pattern X increased from 10 percent to about 30 percent. Pattern W was equally rare in both tasks. As we suggested earlier, Pattern X for both the front and beside placements expresses the theme of social interaction insofar as the body of the placed doll is turned toward the referent object (the referent doll on object-referent trials, the child on self-referent trials) on all three placements. The implication of the change in distribution of use of these patterns across the two tasks is that the self-referent task is more facilitatory of a social-interactive mode with the doll than is the object-referent task. The spatial relationship that the child

imposes between the two dolls apparently does not carry the same degree of social meaning as does the spatial relationship that he imposes between a single doll and his own body.

This interpretation suggests that we look also for the possibility of age and sex differences in incidence of use of Patterns X and Z on these self-referent trials as we did on the object-referent trials. One major problem involved here is that age and sex of subject interacted in complicated ways with testing order in influencing the self-referent placements, as will be discussed presently. For this reason we looked only at patterns used by the children who made their self-referent placements first. The differences were in the direction that we would predict in light of the results of the analyses of location shifting on object-referent trials: girls more than boys, and older children more than younger children, used Pattern X more frequently, though the differences were small (see Table 5). More explicit assessment of this interpretation of the difference between the self-referent and object-referent tasks needs to be done, however.

<u>Effects of testing order</u>.

In our previous study, one of the strongest and most puzzling findings was the interaction of the incidence of kind of self-referent pattern with testing order. Testing order proved to be an important variable in the current study as well. When the self-referent trials preceded the object-referent trials, the majority of placements were in Pattern X or in an irregular pattern. When the self-referent trials followed the object-referent trials, the majority of placements were in Pattern Z. The percent use of Pattern W also increased, and it should be noted that

Pattern W shares orientations with both Patterns X and Z. In other words, the over-all change was toward symmetry, was toward the use of a pattern in which the body of the dolls was aligned in the same direction as the child's body. We note too that when the self-referent trials followed the object-referent trials, the percent use of irregular patterns decreased, suggesting that the preceding experience with the object-referent task had a kind of 'regularizing' effect on the children's placements.

Order of presentation of the self-referent and object-referent tasks had an identical effect on the relative incidence of use of the different kinds of patterns in our previous study. Having thus corroborated these results, we feel much more confident about the interpretation that we offered at that time. In both studies, Pattern Z was the typical pattern observed for the object-referent placements. We think that when the object-referent trials came first, the children generalized a set from that condition so that now, on the self-referent trials, they placed the object to face in the same direction as their own bodies. We suggested, then, that when the self-referent condition followed the object-referent condition, the child was more likely to treat himself as another object in relation to the object that he was asked to place, rather than to treat himself as a <u>user</u> of the object. In light of what we see as the difference in significance of Patterns X and Z, we now feel more inclined to say that the preceding object-referent trials act to suppress the social cue value of the doll for the child.

As we noted in our earlier report, <u>any</u> interpretation of the test-order effect is possible only because the children's placements of the dolls in the object-refernt condition were so highly consistent within themselves and across subjects. Thus the liklihood would seem small that there would

be higher-order interactions between type of placement of the dolls in the object-referent task and pattern dominance in the self-referent task when it followed the object-referent task.

Our interpretation of the test-order effect is really more an interpretive description of the child's placements than it is an interpretation in any larger cognitive sense. That is to say, we still are not sure whether a child who shows himself to be influenced by testing order is behaving 'intelligently' or not. As we shall see when presently we discuss the apparent testing-order by sex of child interaction, this becomes a question of some moment.

We can think of at least one way to interpret the test-order effect. The fact of influence of testing order might be seen as an error factor (Harlow, 1959) of perseveration, that is, as the continuing of behavior despite a change in the situation. In other words, the child does not take into account, in making his placements, the fact that the situation has changed, and continues instead to place the objects as he did before. Another way to express this would be to say that the children influenced by testing order did not appreciate the different kinds of cues on the basis of which the spatial placements could be made. By this interpretation, then, perseveration (i.e., susceptibility to testing order) would seem to be most reasonably viewed as cognitively immature or unintelligent behavior, and one therefore would expect to find less perseveration in older children than in younger children. However, as we have already noted, no age differences in either direction were apparent. It may be, of course, that the age range represented in the current study was too narrow for any such differences to appear.

Inspection of the percentages in Table 5 also suggests that this effect

of test-order order also interacts with the sex of the child. The effects described above appear in all cases to be more pronounced for girls than for boys. According to our interpretation of the test-order effect, this sex difference could be seen as evidence for lesser spatial competence in girls than in boys. Since there is a great deal of other evidence (e.g., Garai and Scheinfeld, 1968) that girls in fact are less skilled in spatial perception than are boys, the current findings, so far as they are related to this larger body of research, would seem to support this interpretation -- that perseveration is a cognitively immature response to a change in the testing situation.

While the younger and older children did not appear to be differentially affected by testing order, it might be recalled in this context that the older children did make more shifts for the 'beside' placements than did the younger children by a marginally significant degree. While this result might be seen as support for our interpretation insofar as response shift reflects sensitivity to a change in the situation, we also should recall that the sex difference for this measure <u>was</u> statistically significant, and that girls switched more often than boys did. Finally, as the correlations showed, only for girls did shifts increase with age. In fact, as we already have implied in our discussion of these scores, we think that neither the age nor the sex differences on this measure are pertinent to the question at hand. Our belief instead is that such shifting evidences a responsiveness to social cues rather than to spatial cues. In other words, girls, and older girls in particular, are responding more often to the face as something toward which social responses are directed and not as some feature that defines the front.

Irregular self-referent placements.

We turn finally to the 77 irregular self-referent patterns -- that is, those not fitting either Pattern W,X, or Z. The distribution of irregular patterns across the various combinations of alignment of the head and body of the doll, and across sex of child and testing order, was exactly what would be expected given the results of the analyses of both the regular self-referent patterns and the irregular object-referent patterns. In brief, the testing-order by sex of child interaction was clearly apparent, and the incidence of irregular patterns was 39% greater when the doll's head-body alignment was divergent than when it was convergent.

The distributions of patterns were examined also in terms of those of the categories developed for analysis of irregular patterns on the object-referent trials that were applicable for the current analysis. (Since only one child on one self-referent placement used an inappropriate location, the location categories were inapplicable.) In these analyses we found some inconsistencies. On the object-referent trials, no irregular patterns involving either a diagonal location or a diagonal orientation were used when the heads and bodies of both dolls were in convergent alignment, whereas in these self-referent trials with a doll with head and body convergent, such patterns were slightly more frequent than were patterns involving non-diagonal orientation changes. Over-all, there were proportionately more diagonal placements in the irregular self-referent patterns (39% of total irregular patterns) than in the irregular object-referent patterns (19% of total irregular patterns).

We see, then, in both self-referent and object-referent tasks, a positive relation between cue complexity, as measured by head-body alignment of the dolls, and irregular responding.

Relative incidence of irregular patterns on self-referent trials and object-referent trials.

Another way to examine the relation between cue complexity and irregular responding is to compare the relative incidence of irregular patterns on the self-referent and object-referent tasks. Our surmise was that the object-referent trials were more complex than the self-referent trials, since in the former, the child had to make his placements in terms of the referent doll while ignoring a potentially salient cue, namely, the position of his own body vis-à-vis the doll. In the self-referent trials, on the other hand, the child had to consider only his own body. The object-referent trials would be more complex for the additional reason that divergent head-body alignment could be introduced in two dolls rather than in only one.

To assess this possible relation, each child's per cent use of irregular patterns on his object-referent trials was subtracted from his per cent use of irregular patterns on his self-referent trials. The resulting average difference scores, with standard deviations, are listed in Table 6 for the eight groups defined by testing-order by sex of

Table 6 about here

child by head-body alignment of the placed doll on the object-referent trials.[6] Each average difference score was tested against an hypothesized null score by direct different t-test. The results indicated that the obtained difference scores were significantly larger than zero in four of the eight groups; however, the differences in each case were in an opposite direction to that predicted. That is, the relative incidence of use of irregular patterns was greater on the self-referent trials than on the

object-referent trials.[7]

We further note that the four non-significant *t*'s were for all the cells in which the object-referent trials had been presented first. As a check on the implied test-order effect, the difference scores for each child were analyzed in a test-order by convergence-divergence of placed doll by sex of child analysis of variance. As expected, the test-order effect was significant ($F = 10.6$, $df = 1/72$; $p < .01$), indicating, together with the results of the *t*-tests, that the relative incidence of irregular patterns was greater in the self-referent trials only when they preceded the object-referent trials, and that when they followed the object-referent trials, there were no differences. None of the remaining main effects nor any interactions were significant (all F's < 1.0).

Two features of these analyses need discussion. The first is the unexpectedly greater relative incidence of irregular patterns in the self-referent trials. The second is the test-order effect. We consider these in turn.

Our first suspicion was that the greater relative incidence of irregular patterns in the self-referent trials was an outgrowth of the fact that there were 12 object-referent trials and only three self-referent trials. The effect of this difference might have been to encourage regularizing of placements on successive trials, as though the child, with repeated instructions to make his placements, gets into a set to make the same kind of placements again and again. By itself, this feature of our design should encourage within any individual child regular and irregular placements equally. But since the same body orientation vis-à-vis the child was presented three times as often as any particular head-body

combination in that same body orientation, we wondered whether over trials the body orientation would gain in salience as a basis for the child's placements. The implication is that irregular patterns, when they occur, should occur most frequently in early trials. To check this, we divided each child's 12 object-referent trials into four blocks of three trials each, and counted the number of irregular patterns used in each block. An analysis of variance for repeated measures was conducted on these scores. Because testing order and alignment of placed doll had proven to be important in previous analyses, they were included as 'between'-subjects variables.

The mean frequencies of irregular patterns in each trial block are listed in Table 7. The results disclosed significant effects of trial

Table 7 about here

block ($\underline{F}$ = 5.38, $\underline{df}$ = 3/228, $p < .01$) and of alignment ($\underline{F}$ = 6.23, $\underline{df}$ = 1/76, $p < .05$). Of the 150 total irregular patterns used, 54 occurred in the first trial block, while the second, third, and fourth blocks contained 34, 29, and 33 irregular patterns respectively. Again, of course, the incidence of irregular patterns was greater in the divergent than the convergent alignment condition, but there was no interaction of alignment with trial block ($\underline{F}$ = 1.06). In this analysis, apparently because of the high variability of scores, the test order effect was significant at only $p < .10$ ($\underline{F}$ = 3.14, $\underline{df}$ = 1/76).

The significant trial block effect suggests that the greater number of object-referent than self-referent trials may indeed have been responsible for the mean difference in relative incidence of irregular patterns on the two kinds of tasks. The implied control analysis would compare

incidence of irregular patterns on the three self-referent trials with only the first three object-referent trials. This analysis was carried out, and the aforementioned differences still held: over-all, there still were more irregular patterns used on self-referent trials than on object-referent trials, though direct-difference t-tests now indicated that the obtained difference scores were significantly larger than zero for only the two girls' groups for whom self-referent trials came first (convergent alignment, $t = 2.10$, $df = 9$, $p < .05$; divergent alignment, $t = 2.59$, $df = 9$, $p < .025$; all t's for remaining six groups ≤ 1.25).

The results of these t-tests imply that the test-order effect was still present and that, in addition, this effect -- in the absence of any apparent <u>over-all</u> sex difference -- had been mediated almost totally by the girls. This would be precisely what we would expect in view of our earlier finding that girls' self-referent patterns were very irregular when they preceded object-referent trials but were very regular when they followed object-referent trials.

A new analysis of variance of these difference scores confirmed these new conclusions (test-order effect: $F = 7.47$, $df = 1/72$, $p < .01$; sex of child: $F < 1.0$; test-order X sex of child: $F = 4.86$, $df = 1/72$, $p < .05$; all other effects: $F < 1.0$).

On the basis, then, of these additional analyses, we conclude that the greater <u>relative</u> incidence of use of irregular patterns on the self-referent trial cannot be laid entirely to the greater absolute number of object-referent trials. There is some residual absolute difference between the tasks that remains to be explained.

There therefore must be some other feature of the object-referent task that acts to decrease pattern variability. We now wonder whether the presence of the referent doll, which we originally saw as a complicating factor, instead has the effect of throwing into relief a particular sub-section of the child's perceptual field, reducing every placement, as it were, to the scale of the referent doll, and on that smaller scale, defining more clearly the major directional axes. The difference perhaps could be likened to the difference between one's sense of direction (i.e., location of one's body in space) as applied to reading the map of a city and as applied to actually orienting oneself in the city. One's own body might not provide so explicit directional cues as an object external to oneself, particularly if that object is scaled to the map size.

Any such interpretation must be made, of course, with the qualification that such an effect, if it exists, is created only or primarily when the self-referent task comes first.

CONCLUSIONS

Significance of test-order interaction.

Our analyses would have been far simpler had the self-referent and object-referent tasks not been so closely linked, since the test-order interaction has prevented us from carrying out some of the finer-grain analyses that we should have liked. On the other hand, the very fact of the interaction -- established now in two separate studies -- is illustrative of our general theme, that the spatial dimensions of front, back, and side are not simple and unidimensional but are complex and multidimensional and that the dimensions themselves are mutually dependent to some degree.

At least this has proven to be so for the age groups with which we have worked so far. This kind of interaction is by no means peculiar to children's performance on the kinds of tasks presented here. It instead is probably a commonplace. Mitler and Harris (1969), for example, in a study of the relation between color-form preference and performance on a concept-identification task involving color or form, found that whichever task came first -- the preference task or the concept-identification task -- affected performance on the task that followed. We think that there undoubtedly are many kinds of concepts that are contextually influenced, that is, whose stability and discreteness exist more in the psychologist's imagination than in the child's behavior, and we might do well to keep this possibility in mind in framing new research.

Even so, there are some firm generalizations in the present research that we feel confident to make.

Uniformity of self-referent placements.

First, we are impressed with the near-perfect uniformity of placements in the self-referent condition. In two studies, 159 of 160 children made every one of their front, back, and beside placements in the appropriate location in relation to their own bodies.

In our report of our earlier work we concluded that such results were hardly surprising inasmuch as they show that the children merely know the fronts, backs, and sides of their own bodies. We now think that our conclusion was not only a simplification but in some respects a misrepresentation of the nature of what the children had accomplished, since such a conclusion assumes that the ability to identify one's front, back, and side implies what is really a different ability to make placements of

other objects in relation to these different planes o the body. The point might be expressed as the difference between learning the name of a fixed attribute of the body and learning a relational concept involving that attribute and some other object. These are different skills and there is no a priori reason why they need be acquired simultaneously. Our surmise now is that learning the name of the attribute comes first, so that substantially younger children (as young, say, as two years) would have been able to point to their front and back (we are not so sure about side) but perhaps would not yet be able to use these same terms relationally.

Role of face and body.

As for the roles of face and body, it is very clear that body cues are overwhelmingly used by all children as the predominant basis for all placements. Our expectation that across age, face cues would replace body cues as the bases for placement, proved wrong. Instead we see that the children used face cues for the most part only in situations where such use would be complementary with rather than antagonistic to the use of the body cues. And it was this particular usage that was greater for older than for younger children (though this was true only for the girls) and greater for girls than for boys. Perhaps a comparison of still younger and older boys than were tested here will disclose the same age difference found for the girls. As for the sex difference itself, perhaps it reflects the generally greater emphasis placed on girls' interpersonal development by parents and by society, though the difference may be as much biological as sociological. For example, Lewis, Kagan, and Kalafat (1966) found that 24-week-old infant boys showed significantly greater "interest

fixations" to pictures of human faces than did infant girls. Are girls innately more predisposed than are boys to attend to faces, and would such differences, to paraphrase Nash's question (1970, p. 199), be the developmental precursor of their greater responsiveness to the face cue in the current experiment? (In a just-completed study we have manipulated the social relationship between the two dolls by identifying them as friends or as enemies, to see what effect this might have on both the incidence of and kind of use of face cues and on the absolute distance between placed doll and referent doll which the child imposes in his placements. Our expectation is that girls will be more sensitive than boys to such manipulations.)

Regularity of behavior.

We should comment, too, on the amount of regularity of response shown. The situation we had designed in our previous study contained numerous bases for irregular responding. In fact we found much more regularity than we expected. In particular, we had expected that the younger children would have responded first to the most frequent and regularly recurring cues for front and back, and that only with increasing age (and its concomitant increasing sophistication with cue possibilities) would embroideries upon this basic regularity occur. We therefore expected the placements of the older children to show wider variability, or at least greater sensitivity to the potential conflict among different cues. Instead, the children, across the age range tested (five to ten years) agreed both with themselves and with one another as to what defined front, back, and beside.

Role of egocentrism

The question will surely be raised as to the possible role of egocentrism in this research, since in what is perhaps the single most influential body of theory on the development of concepts of spatial relationships (Piaget and Inhelder, 1956), egocentrism is a fundamental attribute of the performance of children in the age range of our study. Egocentrism is defined generally as the child's inability to take the point of view of another. In the case of a spatial task such as ours (or the three-mountain task originally used by Piaget and Inhelder), egocentrism would take the more specific form of a literal inability to take the spatial viewpoint of another. To take the point of view of another, the child must be able to visualize or conceptualize the multiple spatial perspectives or points of view possible from different vantage points in relation to some spatial arrangement; further, he must be able to coordinate these multiple perspectives with each other, so that from any given vantage point he can imagine other possible perspectives in relation to the perspective which he himself sees.

As this definition implies, egocentric responses should be most evident in tasks which require representational or conceptual thinking. Not all tasks require such representation. Piaget and Inhelder (1956) distinguish between "representational" tasks, in which the child must transform, reorganize, or integrate information in some way, and "perceptual" tasks, which can be performed without such mental rearrangement of information. Perceptual tasks are within the competence of sensorimotor intelligence, and children perform competently on such tasks from infancy onward.

Following this distinction between representational and perceptual tasks, the front, back, and beside judgments that children were asked to make in

this study seem to fall somewhere in between. On the one hand, the child did not have to go beyond information immediately present in the situation to make these judgments, given that he could identify his own (or the referent doll's) front, back, and side, and given that he defined "in front" "in back", and "beside" in the locations specified by the features by which he defined the body planes front, back, and side. In this respect, the task was perceptual. On the other hand, there are the potentially conflicting bases for judgment to which reference has been made earlier, some of which can be seen as depending upon from whose point of view front, back, or beside is defined: from the point of view of the referent doll, the placed doll, or the child himself. (The further conflict between face cues and body cues is an embroidery upon these basic themes, so far as the present discussion is concerned.) The presence of these potentially conflicting points of view does not <u>require</u> the child to use representation but it does suggest some ways in which egocentrism might be present in the children's responses. We can think of at least three ways in which egocentric responses might have occurred, in particular in performance on the object-referent trials.

At what would seem to grossest level, the terms "in front", "in back", and "beside" might have been defined absolutely by the front, back, and side of the child's own body. For such a child, performance on object-referent and self-referent trials would have been indistinguishable; "in front" would be in front of himself, "in back" behind himself, and "beside" to one side of himself, regardless of whether or not a referent doll was placed in front of him and regardless of instructions. Further, his "in front" placements would have been between himself and the referent doll regardless of the orientation of the referent doll in relation to him.

No child performed in this way, nor would we really expect to find such performance, even in very young children, although the question is open for empirical test.

A child also might have defined front, back, and beside "from his own point of view" by making all of his object-referent placements on different sides of the referent doll but always in the same position in relation to himself, regardless of the orientation of the referent doll. Front and back placements would be made along the plane defined by the front and back of the child's own body, and beside placements would be made on the plane parallel to the plane defined by the child's sides. Although such placements would be made in front of the child and on different sides of the referent doll, they would reveal a lack of sensitivity to changes in orientation of the referent doll. One six & 1/2-year-old boy in our first study consistently made such object-referent placements; and one child in the current study -- the same five & 1/2-year-old kindergarten girl who made the only irregular location placement on the self-referent trials also consistently made such placements. This girl's performance was atypical on both object-referent and self-referent tasks, and we are not sure quite how to interpret it. On the four object-referent trials on which the heads and bodies of both dolls were in convergent alignment, she was the source of two of the three irregular placement patterns occurring among the 40 patterns made by girls in her alignment-of-placed-doll by testing order group. Of the eight object-referent trials on which the head and body of the placed doll were divergent, all eight of her placement patterns located front and back in the same plane in regard to her own body despite the fact that on four of the eight trials the referent doll was turned to her right or her left. Judging from these object-referent

trials, "in front" for her clearly seemed to be in front of herself; but when asked to place a doll in front of herself, she placed it facing herself but on her left. Paradoxically, while her object-referent placements were determined by the plane of her own body, her anomalous self-referent placement was the only placement by any of the children whose location was not determined by the front-back body plane. In view of the multiple irregularities in this child's performance, we conclude that neither her anomalous "in front" placements nor her irregular object-referent placements were accidents, although we do not yet understand what, if any, strategy she was trying to express. After testing, we asked 41 of the 80 children to point to their front and then to their back, and then to explain the difference between front and back. All the children pointed to some appropriate location, including this girl, but she also was one of only five children who could not or would not explain the difference. We believe that her performance was less mature than that of the other children, although we are unwilling to say that performance such as hers might be typical for younger children until we have collected further data.

At yet another level, we suspect that the very regularity that has so impressed us in children's performance on these tasks may be partly a manifestation of egocentrism. Recall that egocentric responding implies not only taking one's own point of view but also an inability to coordinate different perspectives with one another. Recall also that our tasks can be seen as perceptual tasks as defined above, in that the child can respond directly to cues present in the situation, the features defining front, back, and side of either his own body or of the body of a doll. The children appear to have been able to move unhesitatingly from one set of cues

to the other, as though it never occurred to them to ask, "Front (or back, or side) from whose point of view?" They used the available cues as requested, but with virtually no evidence of considering more than one set at a time, or of recognizing the potential conflict between sets of cues. If this interpretation has any validity, we should not be surprised at our failure to date to find age differences in patterns of responding, since spatial egocentrism is characteristic until 10 or 11 years of age, according to the work of Piaget and Inhelder, and since all the children in our studies have been between the ages of four and 10 (with a majority under eight). The one significant age difference found in the current study -- a significantly greater number of side location shifts for older girls than younger girls -- is, as we have said earlier, probably more a reflection of a difference in social concepts than spatial concepts.

Following this line of reasoning, older children and adults might be expected to show greater variation in their placement patterns than have the children tested so far. Or, recalling that our tasks lie somewhere between perceptual and representational tasks, a more appropriate expectation might be that the actual placement patterns of older children and adults might or might not be significantly more variable, since the same perceptual cues are present to guide responding, but that there should be more hesitations, more questions, more statements acknowledging the potential conflict among the different sets of cues upon which placements might be based. Such comments or questions did not occur with the children in either the current or our previous study.

In summary, we think that we have uncovered still more evidence for our belief that reliance on any single test of front-back that is based

on the child's own body will yield a misleading picture of the quality of that child's knowledge of front-back, and that the concept is far more complex and subtle than has been hitherto believed. We do think, though, that we are beginning to puzzle out some of these complexities.

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Footnotes

1. We are grateful to Dorothy Sleuman, Principal, and the staff and children of the Spartan Village Elementary School, East Lansing, Michigan, for their generous cooperation. We also thank Randall Alexander and John Konopa for their help in the conduct of the study. The work reported here was supported by a Bio-Medical Sciences Support Grant from Michigan State University to Lauren Harris and by Michigan State University Faculty Grants to both authors. Portions of this research were reported at the Biennial Meetings of the Society for Research in Child Development, Minneapolis, Minnesota, 4 April 1971.

2. Requests for reprints should be sent to Lauren Harris, Department of Psychology, Michigan State University, East Lansing, Michigan 48823.

3. We independently rated each of the 150 irregular patterns on a scale from 1 ("clearly indicates use of face") to 4 ("clearly indicates absence of use of face"). Agreement was strongest in categories 1 and 4. Eighty percent of the 80 patterns scored as clearly reflecting the use of face cues were rated '1' by both judges; the remaining patterns were rated '1' by one judge, '2' by the other. For the 29 patterns in category 4, there was perfect agreement for 35 percent of the patterns, agreement within one scale point for 48 percent, and agreement within two scale points for the rest.

Additional evidence of the general validity of inferences of use of the face cue in these irregular patterns comes from the remarks of subjects

in this and a subsequent study with 3rd- and 4th-graders. Several children, when asked explicitly what they were trying to accomplish with their irregular placements, were able to express either the goal of effecting a compromise between face and body cues, or of placing on the basis of face cues alone.

4. A complicating feature here is the role of convergence-divergence of the head and body of the placed doll. In three of the four age X sex cells, the percent of location shift is greater when the head-body alignment of the placed doll is convergent, but among younger girls, the opposite is true. We had expected that the amount of shift would be greater in the convergent condition because we have defined a shift as a change that is responsive to a change in the head orientation of the referent doll. When the head-body alignment of the placed doll is also divergent, the subject would be able to use not one but two sets of head-body cues simultaneously, with a possible effect, we believed, being some attenuation in the frequency of location shifts as currently defined. We therefore are unable to explain this discrepant finding at this time.

5. Of the total of 320 possible pairs of trials included in this analysis (80 subjects X four pairs of trials each), on 265 trials, or 86.3 per cent of the total, the three placements constituted a regular pattern, while the patterns on the remaining 44 trials (13.7%) were irregular like those illustrated in Fig. 3. Strictly speaking, these 44 trials perhaps ought not have been included in this analysis because location-shifting

of the sort described above could not unambiguously be assessed in every case. Therefore, even though these trials represented only 13.7 percent of the total, we re-tabulated the scores for the 276 regular trials alone. The attrition caused by subjects' failure to use regular patterns proved to be spread quite evenly across the eight age by sex by alignment cells (range of loss: 3-8 pairs). The scores in this tabulation showed the same distribution as in the tabulation summarized in Table 4.

6. Recall that on the self-referent trials, every child placed the doll with the head-body alignment both convergent and divergent. So in the eight groups listed in Table 6, every child in every cell made placements with both convergent-alignment and divergent-alignment dolls. The subjects, in other words, are divided in the same way as is shown in Table 1.

7. We should note again that on the self-referent trials, only orientation irregularities occurred, with the exception of the single kindergarten girl, whereas on the object-referent trials both orientation and location irregularities occurred. Thus if we define an irregular pattern in terms of location changes only, our prediction of greater regularity on self-referent trials is confirmed. But when we made the implied control comparison between irregular patterns involving only orientation changes, we found that the difference favoring the self-referent trials was even greater. On balance, then, our decision to tally all irregular patterns regardless of whether they involved location changes or orientation changes seems justified.

Table 1. Object-Referent Trials. Incidence (Percent) of Occurrence of Types of Placement Patterns According to Whether Head and Body Cues are Convergent or Divergent for both Placed Doll and Referent Doll.

	(1)	(2)	(3)	(4)	(5)
	Placed Doll Convergent (N=40 Ss)		Placed Doll Divergent (N=40 Ss)		All Combinations (80 Ss)
	Referent Doll Convergent	Referent Doll Divergent	Referent Doll Convergent	Referent Doll Divergent	
	4 trials	8 trials	4 trials	8 trials	12 trials
Pattern					
W	16.9	13.1	12.5	13.1	13.9
X	11.2	12.2	8.8	6.9	9.7
Z	65.1	62.2	59.4	55.9	60.7
Irregular	6.9	12.5	19.3	24.1	15.7

Table 2. Object-Referent Trials. Number of Children Using the Same Placement Patterns on at least Eight of the 12 Object-Referent Trials

	Girls				Boys				
	Self-Referent First		Object-Referent First		Self-Referent First		Object-Referent First		
	Head-Body Alignment of Placed Doll				Head-Body Alignment of Placed Doll				
Pattern	Con.	Div.	Con.	Div.	Con.	Div.	Con.	Div.	Total
W	1	0	0	1	1	2	1	1	7
X	2	1	0	0	0	0	3	0	6
Z	4	5	8	6	9	7	5	6	50
Total	7	6	8	7	10	9	9	7	63

Table 3. Object-Referent Trials. Incidence (percent) of occurrence of types of irregular placement patterns According to Whether Head and Body Cues are Convergent or Divergent for both Placed Doll and Referent Doll.

	Placed Doll Convergent (N=40 Ss)		Placed Doll Divergent (N=40 Ss)		
	(1) Referent Doll Convergent	(2) Referent Doll Divergent	(3) Referent Doll Convergent	(4) Referent Doll Divergent	Total
One Placement Different					
Orientation Only	5.2	4.5	7.1	20.7	37.4
Location Only	.6	.6	.6	.6	1.9
Diagonal Orientation Only	0	0	1.3	1.9	3.2
Diagonal Location Only	0	.6	.0	0	.6
Diagonal Orientation and Location	0	3.3	1.3	1.3	5.8
More Than One Placement Different					
Orientation Only	1.9	1.3	7.8	13.6	24.5
Location Only	0	12.3	.6	4.5	17.4
Diagonal Orientation Only	0	0	0	0	0
Diagonal Location Only	0	.6	.6	0	1.3
Diagonal Orientation and Location	0	0	0	.6	.6
Mixed Types	0	1.3	1.3	4.5	7.1
Total	7.7	24.5	20.0	47.7	100.0

Table 4. Object-Referent Trials. Mean number of Changes in Location of Beside Placements When Divergent Head Orientation of Referent Doll Changes from Left to Right or Right to Left of Referent Object. (n's = pairs of trials, number of trial pairs per child = 4; n per cell = 40, 10 Ss X 4 trial pairs)

	Girls			Boys			
	Younger	Older	Total	Younger	Older	Total	Grand Totals
Placed Doll Convergent	$\bar{X} = 1.0$ $s = 1.15$	$\bar{X} = 2.4$ $s = 1.35$	$\bar{X} = 1.70$	$\bar{X} = 1.0$ $s = 1.25$	$\bar{X} = 1.2$ $s = 1.55$	$\bar{X} = 1.10$	$\bar{X} = 1.40$
Placed Doll Divergent	$\bar{X} = 1.3$ $s = 1.42$	$\bar{X} = 1.4$ $s = 0.97$	$\bar{X} = 1.35$	$\bar{X} = 0.7$ $s = 0.82$	$\bar{X} = 0.9$ $s = 0.88$	$\bar{X} = 0.80$	$\bar{X} = 1.08$
Totals	$\bar{X} = 1.15$	$\bar{X} = 1.90$	$\bar{X} = 1.53$	$\bar{X} = 0.85$	$\bar{X} = 1.05$	$\bar{X} = 0.95$	$\bar{X} = 1.24$

All Younger Ss: $\bar{X} = 1.00$; All Older Ss: $\bar{X} = 1.48$

Table 5. Self-Referent Trials. Incidence of Use of Placement Patterns W, X, and Z, and irregular Patterns as a Function of Sex and Age of Child, Testing Order, and Alignment of Placed Doll as seen from Child's Perspective (First score = number of times pattern was used). Total number of trials = 240 (three 3-placement trials/subject).

	Convergent Alignment		Divergent Alignment (head to right)		Divergent Alignment (head to left)		Totals
	Younger	Older	Younger	Older	Younger	Older	
Girls							
Self-Referent first							
W	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
X	5 (25%)	7 (35%)	3 (15%)	4 (20%)	5 (25%)	4 (20%)	28 (11.66%)
Z	0 (0%)	1 (5%)	0 (0%)	1 (5%)	0 (0%)	1 (5%)	3 (1.25%)
Irregular	5 (25%)	2 (10%)	7 (35%)	5 (25%)	5 (25%)	5 (25%)	29 (12.08%)
Object-Referent first							
W	1 (5%)	1 (5%)	1 (5%)	3 (15%)	1 (5%)	2 (10%)	9 (3.75%)
X	3 (15%)	1 (5%)	4 (20%)	0 (0%)	4 (20%)	0 (0%)	12 (5%)
Z	4 (20%)	7 (35%)	4 (20%)	5 (25%)	4 (20%)	5 (25%)	29 (12.08%)
Irregular	2 (10%)	1 (5%)	1 (5%)	2 (10%)	1 (5%)	3 (15%)	10 (4.16%)
Boys							
Self-Referent first							
W	0 (0%)	1 (5%)	0 (0%)	1 (5%)	0 (0%)	3 (15%)	5 (2.08%)
X	3 (15%)	5 (25%)	4 (20%)	5 (25%)	1 (5%)	3 (15%)	21 (8.75%)
Z	1 (5%)	2 (10%)	3 (15%)	1 (5%)	4 (20%)	1 (5%)	12 (5.00%)
Irregular	6 (30%)	2 (10%)	3 (15%)	3 (15%)	5 (25%)	3 (15%)	22 (9.16%)
Object-Referent first							
W	0 (0%)	4 (20%)	0 (0%)	3 (15%)	1 (5%)	2 (10%)	10 (4.16%)
X	2 (10%)	2 (10%)	1 (5%)	2 (10%)	2 (10%)	2 (10%)	11 (4.58%)
Z	4 (20%)	3 (15%)	6 (30%)	3 (15%)	5 (25%)	2 (10%)	23 (9.58%)
Irregular	4 (20%)	1 (5%)	3 (15%)	2 (10%)	2 (10%)	4 (20%)	16 (6.66%)
							=99.95%

Table 5. Proportion of Irregular Patterns on 3 Self-Referent Trials minus Proportion of Irregular Patterns on 12 Object-Referent Trials as Function of Sex of Child, Testing Order, and Alignment of Placed Doll.

	Boys		Girls		
	Self-Ref first	Object-Ref first	Self-Ref first	Object-Ref first	Totals
Convergent	$\bar{X}$ = .33 (s = .41)	$\bar{X}$ = .10 (s = .41)	$\bar{X}$ = .36 (s = .40)	$\bar{X}$ = .02 (s = .20)	$\bar{X}$ = .21
Divergent	$\bar{X}$ = .23 (s = .36)	$\bar{X}$ = .00 (s = .29)	$\bar{X}$ = .33 (s = .40)	$\bar{X}$ = .01 (s = .32)	$\bar{X}$ = .14
Totals	$\bar{X}$ = .28	$\bar{X}$ = .08	$\bar{X}$ = .34	$\bar{X}$ = .01	

Note: numbers in parentheses = std. dev. of difference-of-proportion scores for 10 difference scores in each cell.

Table 7. Object-Referent Trials: Mean Number of Irregular Patterns in each Trial Block as a Function of Alignment of Placed Doll and Testing Order.[a]

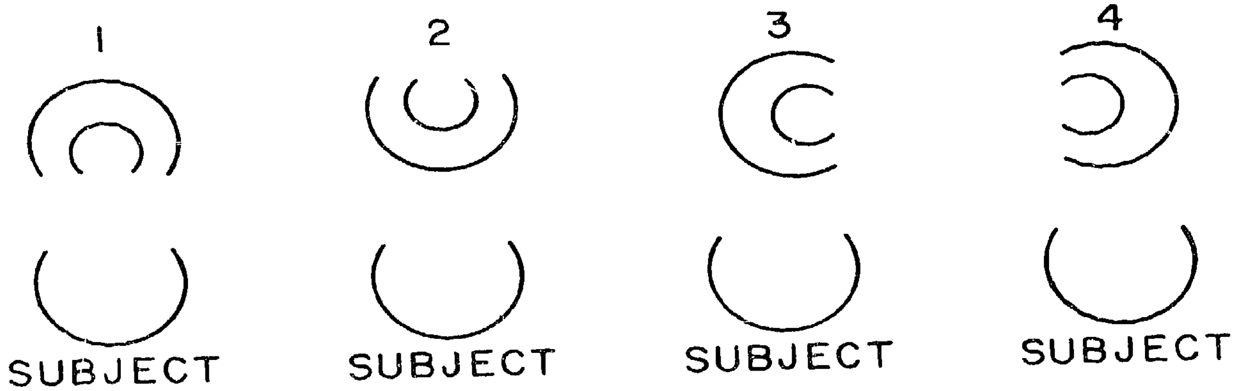
		Head-Body Alignment of Placed Doll							
		Convergent				Divergent			
		Trial Block				Trial Block			
		1	2	3	4	1	2	3	4
Test Order	Self-Referent-1st Object-Referent 2nd	.60 (.60)	.05 (.22)	.10 (.45)	.25 (.70)	.45 (.76)	.30 (.81)	.35 (.66)	.55 (.94)
	Object-Referent-1st -Self-Referent 2nd	.45 (.83)	.25 (.55)	.15 (.64)	.20 (.55)	1.10 (1.07)	1.05 (1.23)	.75 (1.21)	.65 (1.23)

[a]Number of Ss represented in each cell = 20; number of trials represented in each cell = 80; in each 3-trial block = 60 (20 Ss X 3 trials). Numbers in parentheses are std. devs.

Fig. 1. Object-Referent Condition: Combinations of Head-Body Alignments of Referent Doll in Each of Four Different Orientations.

Shown are schematic representations of the referent doll, as seen from above, with the outer circle indicating the body and the inner circle indicating the head. The open sides of the circles indicate the front; thus the open side of the outer circle indicates the front (ventral side) of the body; the open side of the inner circle indicates the front of the head (the face). Therefore, in combination #1, the head and body of the referent doll are aligned convergently. The subject, on each trial, is represented as facing the doll (the drawing shows only the subject's body).

HEAD AND BODY CONVERGENT



HEAD AND BODY DIVERGENT

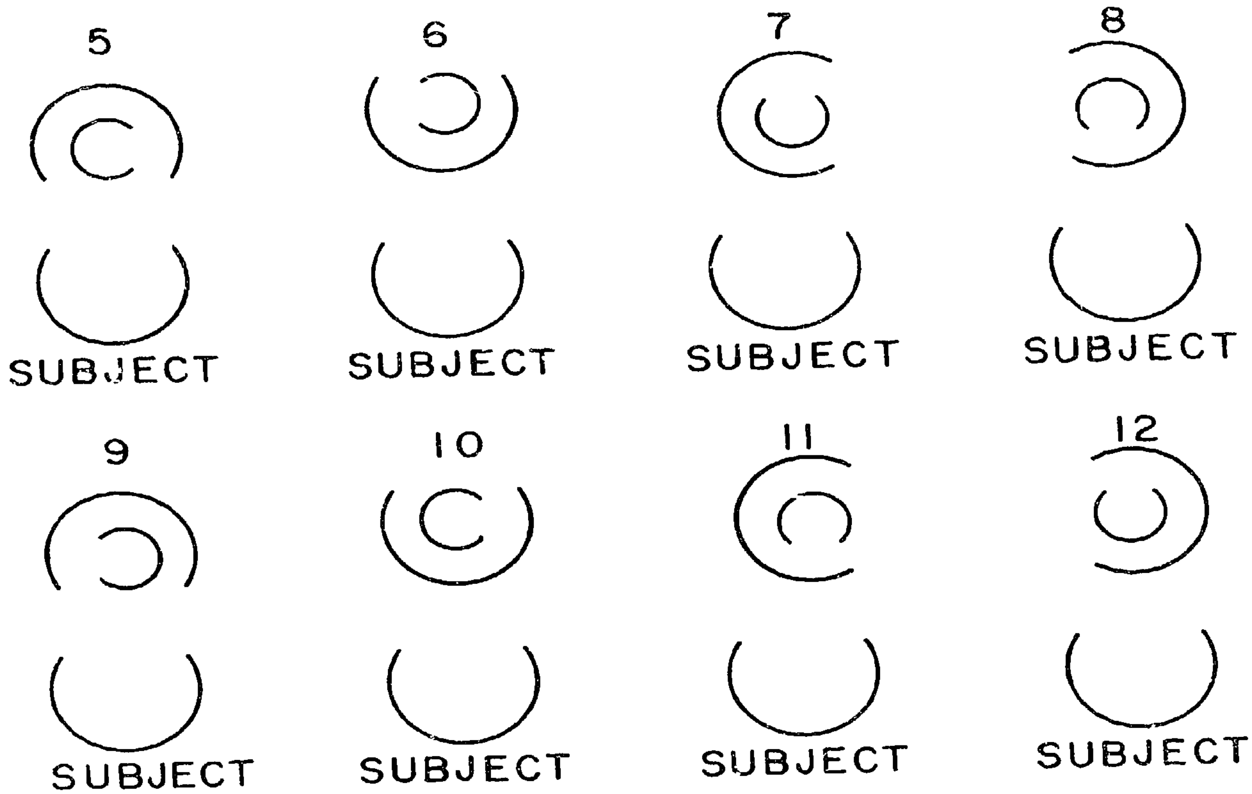


Fig. 2. Object-Referent Condition: Characteristic Placement Patterns Indicating Orientation of Bodies of Dolls.

'F', 'B', and 'S' indicate the locations of the placed doll for front, behind and (be)side placements, respectively. 'R' = referent doll. Although all the drawings depict the referent doll and the subject facing in the same direction, the same placement patterns occurred when the body of the referent doll was turned to either side of or away from the subject. Side placements occurred on either side; the drawings indicate the location of the more frequent placements.

The same patterns appeared in the self-referent condition. To illustrate these patterns, simply substitute 'subject' (in same orientation as shown) for the referent doll.

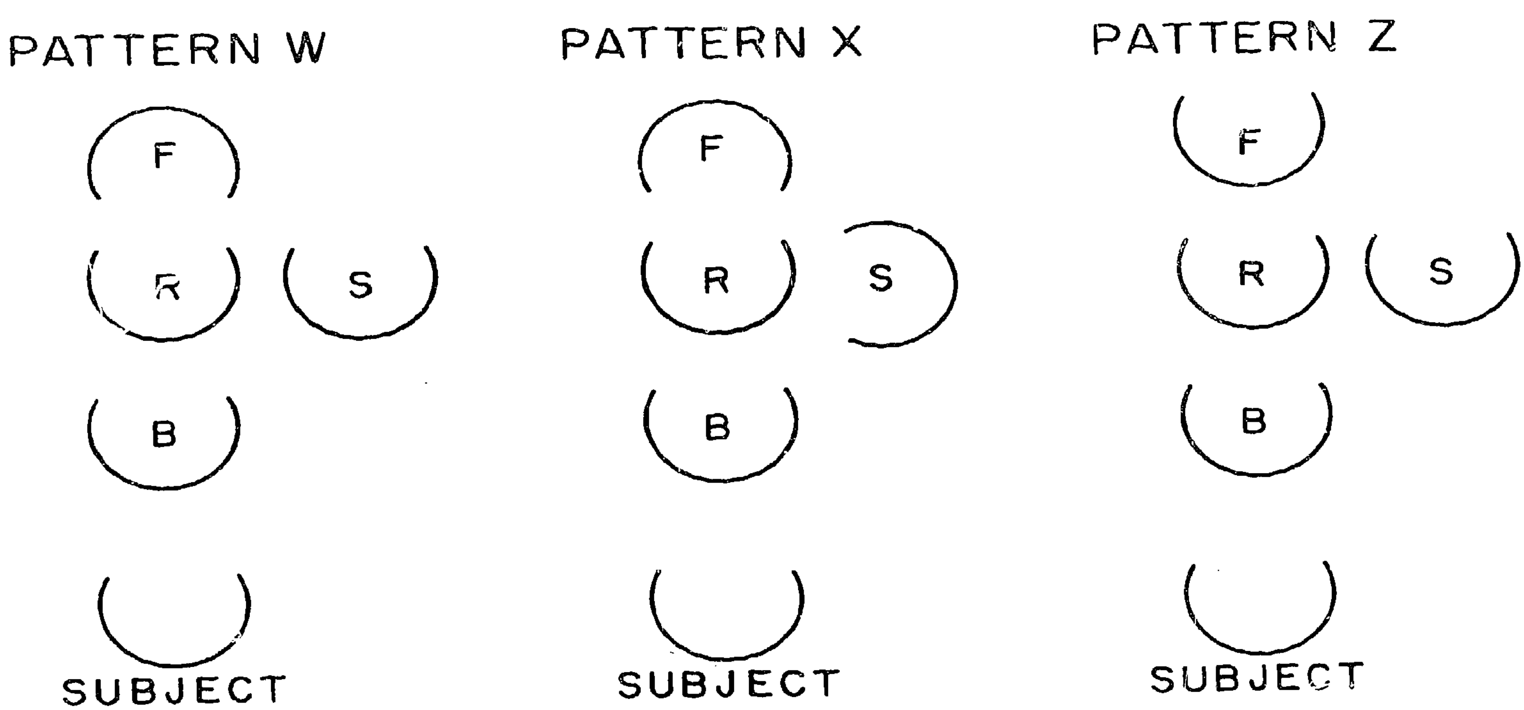

PATTERN W
F
R
S
B
SUBJECT
PATTERN X
F
R
S
B
SUBJECT
PATTERN Z
F
R
S
B
SUBJECT

Fig. 3. Object-Referent Condition: examples of placement patterns that differ from predominant patterns (W,X,Z).

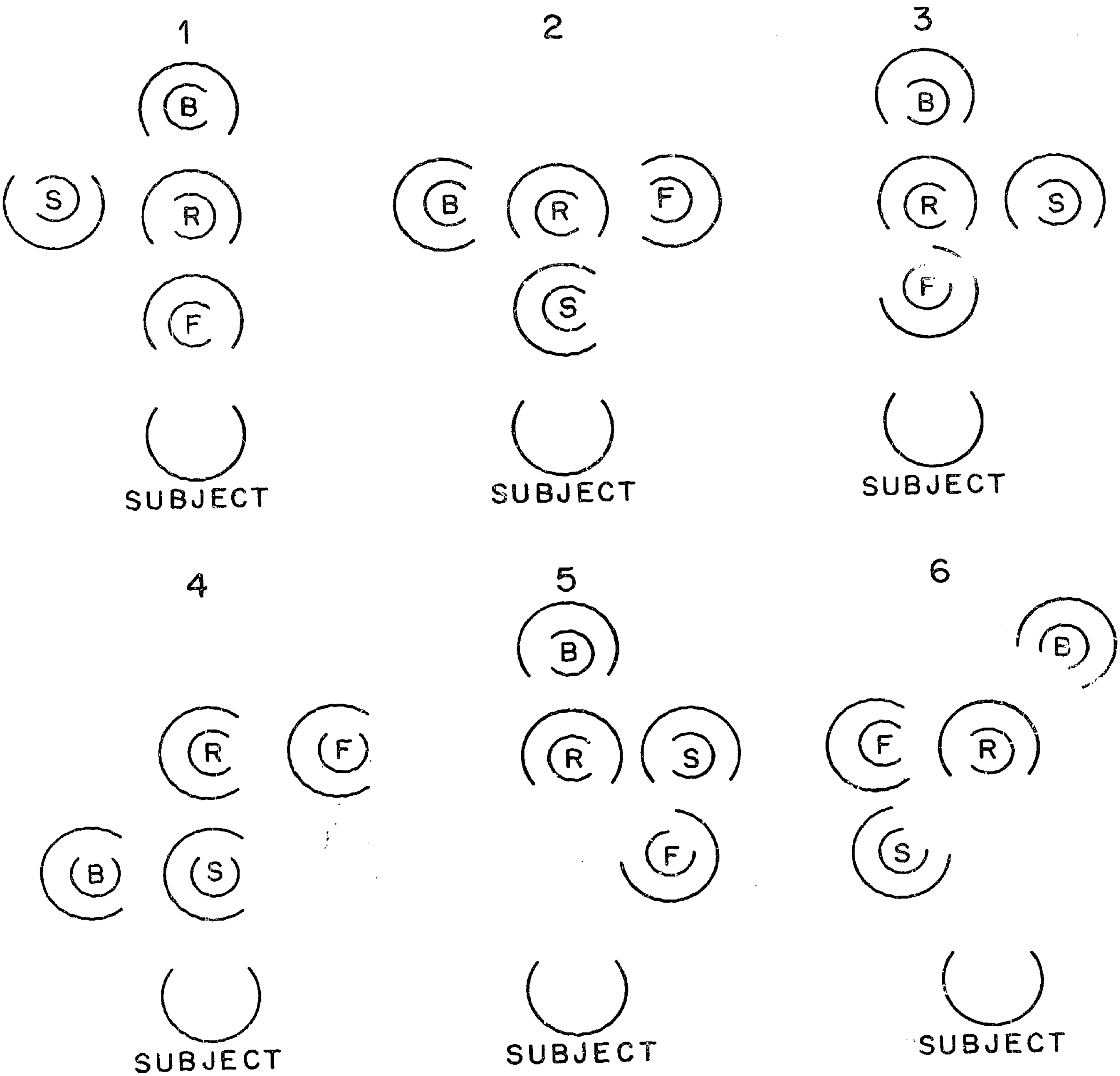
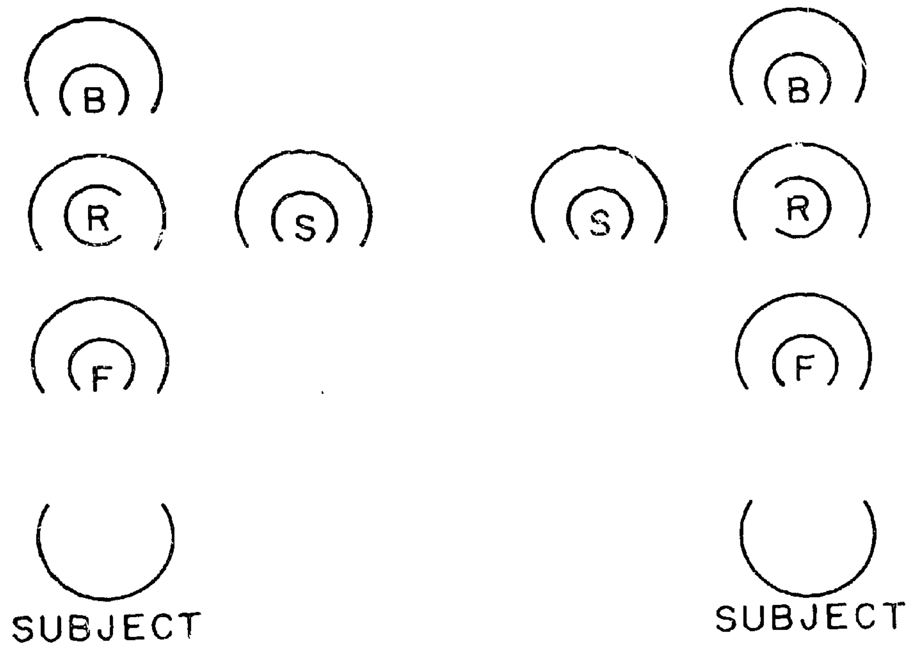

1
B
S
R
F
SUBJECT
2
B
R
F
S
SUBJECT
3
B
R
S
F
SUBJECT
4
R
F
B
S
SUBJECT
5
B
R
S
F
SUBJECT
6
B
F
R
S
SUBJECT

Fig. 4 Object-referent condition: examples of Pattern-Z placements that reflect use or absence of use of face cue.

USE OF FACE CUE



ABSENCE OF USE OF FACE CUE