A STUDY OF RIGHT AND LEFT ASYMMETRY IN VISUAL SPACE PERCEPTION

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY
Clarence M. Williams

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A STUDY OF RIGHT AND LEFT ASYMMETRY IN VISUAL SPACE PERCEPTION

by

Clarence M. Williams

AN ABSTRACT OF A THESIS

Submitted to the College of Science and Arts of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

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Two specific questions about the differences noticed by observers in spatial and other properties of objects appearing at various positions in the visual field were devised to determine, if possible, some of the factors underlying these phenomena. First, using relatively unstructured scenes, will young observers tend to orient themselves obliquely to the plane of the scenes in a consistent manner; and second, will these same observers see differences in asymmetric photographs and their mirror-images which can be taken as evidences of right-left asymmetry.

The subjects for both experiments were sixteen boys and eighteen girls ranging in age from eleven to thirteen years and in intelligence from an I. Q. of 66 to 120.

The apparatus for Experiment I was made up of six mimeographed copies of a depictation of a desert scene with one object placed at a different left to right position across the horizon in each scene. The subjects were asked to draw a response object <u>in-line</u> between themselves and the object in its various positions.

The results indicated that the majority of the subjects, as a group, did not maintain a consistent orientation on one side of the scenes. When individual responses

were analyzed, however, it was found that individual subjects did tend toward a consistent response positions with regard to the differing positions of the stimulus object. These positions were not consistent from subject to subject.

The apparatus for Experiment II consisted of five paper board cards on which were mounted an asymmetric photograph and its mirror-image. A rack was constructed for holding these cards at a suitable distance and height for viewing. Each subject was asked to look from one side of a septum to the other at the photograph and its mirror-image and respond either "left" or "right" to the appropriate questions for each of the five sets of picture materials. These questions were about asymmetric features in the photographs and their mirror-images upon which a criterion group of five adults agreed as being different. There were two differences in each picture-pair from which questions were devised making ten in all. The results, in terms of "left" or "right", were summed for all subjects and a differences between proportions test applied to the totals for each question. Two of them yielded significant data consistent with right-left asymmetry.

The following seems justified by the obtained data: (1) The sample as a group did not maintain a consistent

orientation with respect to an object placed in various positions in a scene.

(2) Differences in asymmetric photographs and their mirror-images were seen readily by all subjects. Only two of the ten picture differences used yielded significant data in comparison to the differences seen by a criterion group of five adults.

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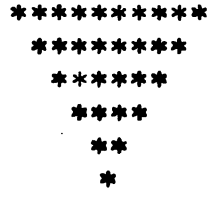

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Introduction

A general problem in perception has to do with the differences noticed by observers in spatial and other properties of objects appearing at various positions in the visual field, particularly in the one lateral half versus the other.

Differences in the perception of the right and left fields of viewed scenes have been recognized for quite some time. Thus, artists place their featured person or object on the left side of a scene. Research abroad (7), (8) has reported a tendency for European artists to use the left half of the visual field to introduce movement into a picture, since there is more clarity and distinction here. On the other hand, the right half of the picture is said to leave more room for the play of the imagination.

Theory to account for the differing efficacy of the right and left halves of viewed scenes has been developed by Gaffron (3) in this country and by several investigators abroad (7), (8). Gaffron posited a process called the "glance-curve" to account for an empirically demonstrated asymmetry of perceptions in the right and left fields of viewed scenes. This curve describes two things in particular: (1) that the observer orients himself in a particular position with reference to the scene or target viewed. The observer treats the scene he views as if he placed himself in a position so as to obliquely regard it from the left.

And; (2) the observer, in effect, looks first into the foreground and progresses from there obliquely into the mid and back-ground and then somewhat to the right. This motion or sequence of observing forms an inspection curve which does not stay within the plane of a two dimensional picture but has to do with the interpretation of the scene as containing third dimensional properties.

The theory also holds that this behavior is a result of learning and probably describes more particularly western peoples who read from left to right. Some work has been done to determine whether or not this observed asymmetrical perception is a product of the reading habits learned in our society. Forgays (1) investigated the relation of positions in a two dimensional field in which certain material showed up most readily as a function of the learned reading habits. Some observers were Orientals who had learned to read from top to bottom and from right to left. Others were those who had learned to read from right to left and still others who had learned to read from left to right.

This same investigator, in another study (2), found that words exposed tachistoscopically were recognized more easily when they were in the right peripheral field (to the right of a fixation point) and that this superiority of the recognition of the words in the right field was significantly related to educational grade level.

However, the present interest does not lie

particularly in Gaffron's specific suppositions and assertions regarding a "glance-curve." First of all because facilities for testing the theory are not available and secondly because it seemed to the experimenter that the crux of the problem lay in discovering the psychophysical relations between the visual target and the response it evoked. By response, is meant the introspective protocols and/or any overt response made to the target, such as reacting to certain elements rather than others, or reacting so as to indicate a "mispositioning" of them. Accordingly, the experimenter's attention was directed so as to discover some of the data relating to the above-mentioned responses and reactions. The first stated implication was that the subject assumes a functional position with reference to the target, such as viewing it obliquely as if off to the left of the center of the scene. This seems testable.

It is not certain from the literature just what the specific conditions of experimentation were in the work of Gaffron whose assertions regarding the functional asymmetry of the perceptual-visual field with which the experimenter is mainly concerned. Hence further experimentation might well consist in an investigation both of the extent to which some of the asymmetry phenomena are reproducable and of the conditions most effective in obtaining them.

It seemed desirable to use a group of young subjects in answering both of these questions. For nothing had been

said about their behavior in contrast to that of adults, except that it was implied that learning was involved in producing the asymmetry. If so, one might suppose that certain helpful understandings about this kind of perception could be obtained, first of all, by reducing target simplicity but not beyond the point at which it would serve as a three dimensional scene for the observer, and secondly by using children about whom it may be argued that the extent of learning has not yet resulted in habitual response patterns.

Problem

In light of what appears to be a learned mode of looking at a three dimensional scene or a two dimensional representation of a three dimensional scene, the experiments being reported here were designed to answer, if possible, the following specific questions: (1) using a relatively unstructured asymmetric scene consisting of a target marked off with several simple lines to function as a prairie, or desert, or a plain from which the horizon and a distant object were visible to the observer, will young observers tend to orient themselves obliquely to the plane in a consistent manner?; and (2) will these observers see differences in asymmetric photographs and their mirror-images which can be taken as evidence of right-left perceptual asymmetry?

Subjects

The sample used for both experiments was a sixth grade class of sixteen boys and eighteen girls in the public schools of Lansing, Michigan. They ranged in age from eleven to thirteen and in intelligence from an I. Q. of 66 to 120 (California Mental Maturity) with a mean of 95.5 and a standard deviation of 12.42. Because of three absences the number of subjects for Experiment II was twenty-nine.

Experiment I

Apparatus

A simple, unstructured depictation of a desert scene was drawn consisting of a plain picture frame, a horizon, and one telephone pole in the distance as in Figure I. Additional drawings in which each of three positions of the telephone pole on the right side of the scene was matched by a mirror-image position on the left side were developed thus making possible six stimulus scenes in all for each subject. These pictures were mimeographed and, after a random order of presentation was determined, were stapled together so that each subject received a set of the six stimulus scenes.

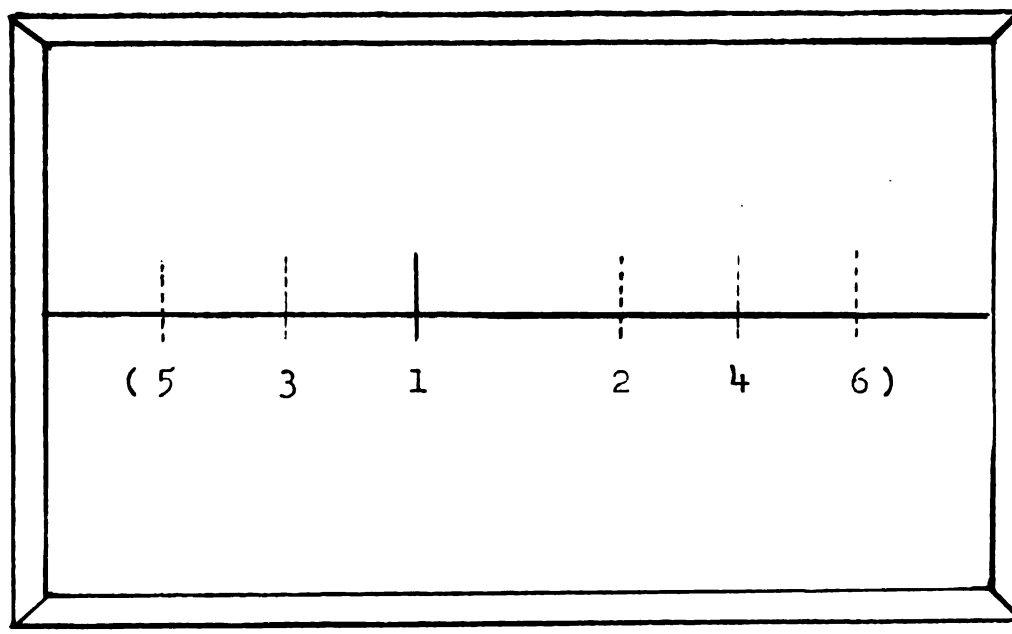

Fig. 1. Unstructured desert-type scene with six pole positions as indicated. Numbers refer to order of presentation.

Procedure

After each subject had the materials on his desk, the experimenter read the following directions: "Leave these papers face down until you are told to turn them over. This is going to be a short experiment involving your eyes. You will find on each of the sheets of paper a picture of a desert. In each picture is drawn a pole like a telephone pole or an electric company pole. Your assignment is to draw one more pole in each picture so that it will be in line between you and the pole already there. It can be just a vertical (the experimenter made a vertical motion in the air) pencil or ink drawn line and all that is asked of you is that it looks like it is in line between you and the pole already in the picture. You can think of yourself as one of the poles if you like. Are there any questions?" There were a number of questions and as it became apparent that a few of the subjects were not getting the gist of the idea, the experimenter drew a sample scene on the blackboard and demonstrated what was wanted and tried to explain carefully each question that arose.

Results

In order to determine whether or not the subjects tended to orient themselves in a consistent manner with respect to the stimulus scenes, a line was cast from the lower end of the pole in each scene through the lower end of the response pole and down to the bottom of the picture. The bottoms of the pictures then were divided in half and the responses scored either "left" or "right." Some response lines ended on the dividing line and were scored, for purposes of this analysis, "left" or "right" according to the direction in which they were headed. For scene 1 fourteen subjects oriented themselves on the left half of the picture and eighteen subjects oriented themselves on the right half; eighteen subjects oriented themselves on the left half for scene 2 and fourteen on the right half; an even split of sixteen-sixteen was obtained for scene 3; scene 4 divided eighteen left and fourteen right; an even sixteen-sixteen split again on scene 5; and scene 6 was divided nineteen left and thirteen right. None of these orientations proved different from that which would be obtained by chance when tested statistically using the test for differences between proportions (6).

An analysis was then made of the consistency of the individual subject's responses. As shown in Table II, twenty-five subjects divided their responses rather evenly between the left and right response positions; two sub-

jects maintained a left orientation; three maintained virtually a dividing line or center orientation; one divided his responses left, center, right; and one used the positions center and right.

Table I. Left and Right orientations of subjects according to a line cast from depicted pole through response pole down to the bottom of picture. Significance tested with differences between proportions test (6).

Scenes	SUBJECT ORIENTATIONS		Signif.
	Left	Right	
1	14	18	n.s.
2	18	14	n.s.
3	16	16	n.s.
4	18	14	n.s.
5	16	16	n.s.
6	19	13	n.s.

Table II. Orientations taken by individual subjects.

Number of Subjects	ORIENTATIONS		
	Left of Center	*Center	Right of Center
25	3	0	3
2	6	0	0
3	0	6	0
1	2	2	2
1	0	3	3
32			

* Center indicates no preference.

Experiment II

Apparatus

Five asymmetric photographs and their mirror-images (made by reversing the negatives in the printing process) were selected for use as the stimulus materials. The criterion for selection was asymmetry involving objects seen every day such as: a church, house, fireplace, lake, etc. Each photograph and its reversal was attached to a strip of paper-board which measured six by thirteen inches. The distance between the photographs was eight inches center-to-center. This made five stimulus cards in all (Figure 2). The asymmetric object or feature of the photograph was toward the outside or away from the center of the stimulus card. A rack for the display of the cards was constructed of heavy corrugated box board as shown in Figure 3. A high septum extended the length of the display rack. A slot between the septum and the back of the rack plus a support on either side of the septum made for easy and convenient insertion of the stimulus cards. The subjects sat at position (A) on an adjustable stool which was raised or lowered so that the stimulus card was on a level with the subject's eyes.

Sample photograph and its mirror-image.

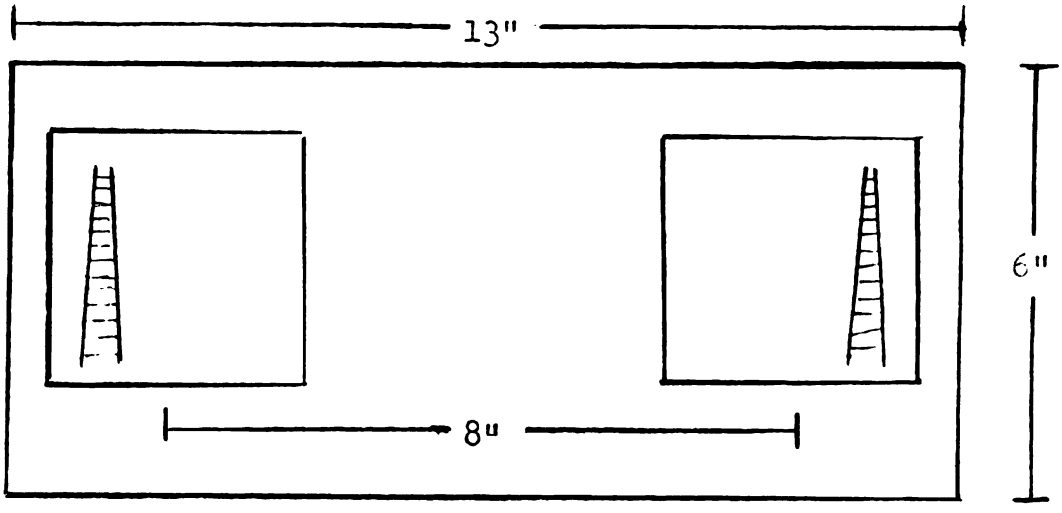

Fig.2. Stimulus card showing how photographs were mounted and orientation of the asymmetric feature.

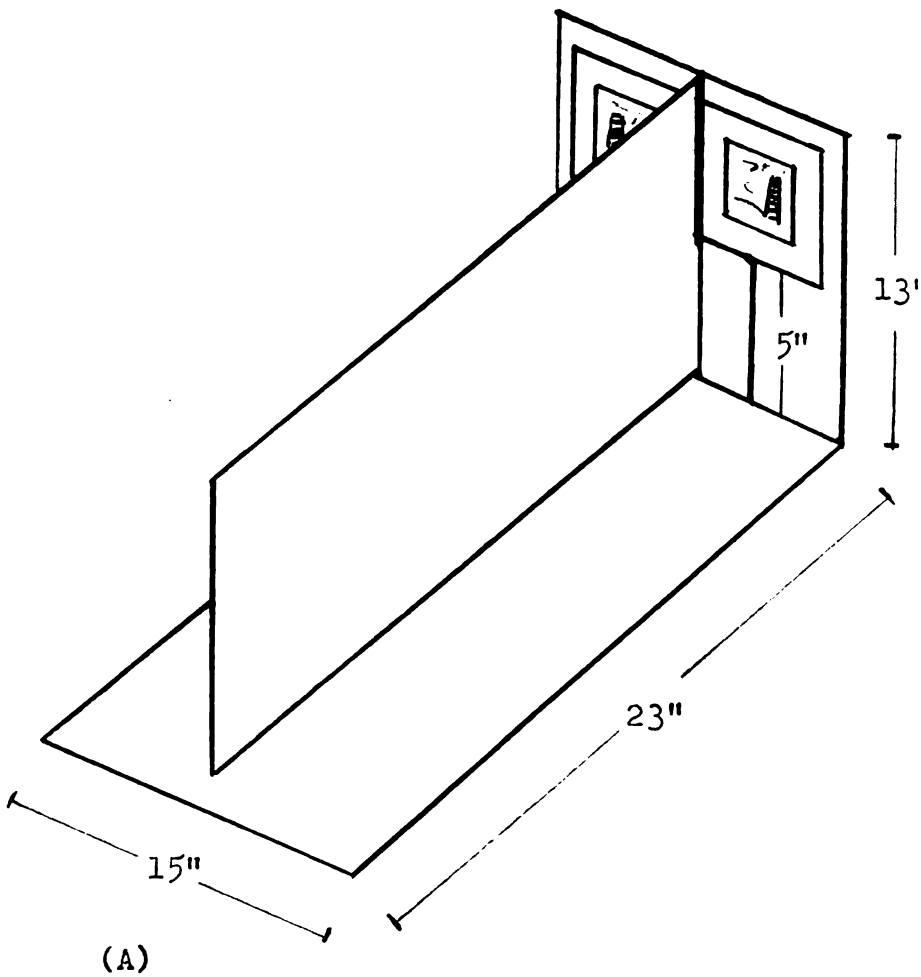

Fig. 3. Display rack with septum arranged so that only one end of the stimulus card can be seen at one time. Subject sat on adjustable stool at position (A).

Procedure

Since the experimenter was faced with the problem of showing these stimulus materials to eleven and twelve year-old subjects, it seemed proper to determine in advance what differences in the photographs adults would detect. Accordingly, five adults as a criterion group were asked individually to look at the stimulus cards and tell if they could readily note any differences between the photographs and their mirror-images. Differences were seen by all of the adults and a list was kept of the responses of each. The adults also stated that they had never heard of the "glance-curve" when the purpose of their participation was revealed. In comparing the items in their responses it was found that they all agreed on at least two differences in each pair of stimulus photographs. Questions were then devised about each of the agreed-upon differences and the cards named according to some prominent feature in the photograph. Then the order of presentation for the next step of the experiment was determined by the throwing of a die with this result: (1) House and road; (2) Church and road; (3) Fireplace and chairs; (4) Three men; and (5) Derrick and lake. The following ten questions were asked of all child subjects as they viewed the appropriate stimulus card:

(1) a. Which picture has the longer road?

b. In which picture is the road curved the most?

(2) a. In which picture can you see the farthest or the most distance?

b. In which picture does the road look longer?

(3) a. In which picture does the fireplace look larger or bigger?

b. See the chair next to the fireplace? In which picture can you see onto the cushion of that chair easier?

(4) a. In which picture is the outside man nearer to you?

b. In which picture is the center man taller?

(5) a. In which picture can you see farthest over the water?

b. In which picture is the ladder on the derrick longer?

All of the subjects were instructed to answer either "right" or "left" after looking from one picture to the other. They were allowed to shift back and forth once or twice, if necessary, before making a response. There seemed to be no difficulty in picking a response immediately. The rack was situated against the subject's chest and so arranged that only one side of the septum could be viewed at one time unless the subject turned his head.

Results

To be able to quantify the results obtained in this experiment it was necessary to determine which responses favored the right-left hand asymmetry in perception in the visual field. A count was then made of responses which were considered to be consistent or non-consistent with this asymmetry. A one-tailed test (6) of the differences between the resulting proportions was applied to the answers for each of the questions. It was found that all ten questions yielded overall data (Table III) dissimilar for the picture and its mirror-image but the data for eight of the ten were not significantly different from that which would be obtained by chance. On two of the questions there were significant differences of asymmetry at the two and five per cent level, respectively, and in the direction predicted by the "glance-curve." These two were number (4) b. (Three men) In which picture is the center man the taller?; and (5) b. (Derrick and lake) In which picture is the ladder on the derrick longer?

Table III. Results from questions about five asymmetric photographs and their mirror-images.

Photo-graphs	Quest-ions	CON-FIRMING	NON CON-FIRMING	*Signif.
1	a.	14	15	n.s.
	b.	13	16	n.s.
2.	a.	17	12	n.s.
	b.	13	16	n.s.
3.	a.	16	13	n.s.
	b.	15	14	n.s.
4.	a.	18	11	n.s.
	b.	20	9	5 %
5.	a.	14	15	n.s.
	b.	21	8	2 %

* Differences between proportions test (6).

Discussion

Experiment I

As shown in the data of Table I, the majority of the subjects in this sample did not orient themselves in a consistent manner to the stimulus situation. When the analysis was made in terms of the individual's own consistency of orientation (Table II), it was found that nearly all of the subjects did adopt a consistent manner in orienting themselves to the stimulus situation. The manner of orientation differed, however, for different subjects and no conclusion regarding a fixed orientation on the left side of a picture or scene is warranted. The relatively unstructured nature of the scenes seemed to be somewhat of a handicap to the type of subject used. Since Gaffron, however, had implied that the behavior she described is incidental to having learned to read and, since Forgays somewhat substantiated the relation of reading to the right-left behavior in visual response, the analysis of the obtained data might be interpreted as limiting the generalization these researchers arrived at. It must be assumed that the present sample of of eleven, twelve, and thirteen year-olds were at different stages of learning to read or of forming the "glance-curve" or that the theory of Gaffron needs re-examination. Further experimentation could be devised so as to become more definitive on this point. For example, it

might prove helpful to know how both younger and older subjects respond to the same type of stimulus materials.

In the present case we find the majority of subjects, twenty-five in number, to divide their responses rather evenly between left and right orientations; three subjects to pick a center orientation; two subjects a left orientation; and two who picked no consistent orientation. This breakdown could be likened to a group response on many aspects of growth and learning with the majority still definitely wavering between the extremes of response; a small proportion of the group having attained the response expected; and another small proportion of the group with various responses probably less extreme in either direction.

Discussion

Experiment II

Table III shows that a significant difference in favor of the results expected by Gaffron's theory was found in the responses of twenty-nine subjects in only two of the ten questions asked. The responses for the remaining eight questions were no different than what would be expected by chance. Even though the majority of the ten questions yielded answers not statistically significant there does seem to be a trend in the direction of the expected results.

The question of whether or not the asymmetric photographs were all of equal value insofar as testing the expectations arises here. If they were all of equal eliciting value, then all of the answers for or against the formulation could be summed and perhaps another overall interpretation of the results obtained. As yet there is no criterion of asymmetry and of the various other factors entering into it other than those which can be inferred from previous research and perceptual observations. Therefore, a start had to be made somewhere and it was thought worthwhile to perform the experiment herein described in order to further the understandings of some of the relations that underlie this area of study.

What can be said about the responses of the children-subjects is that they were made readily. The subjects did

not have to be urged at all and seemed quite willing to make a choice between the photograph and its mirror-image. In other words, they actually did see differences between the elements in the picture and its mirror-image as readily as the adults. It would seem though, that they were less consistent from subject to subject as the data indicates.

There is one important consideration that has not been heretofore mentioned. The experimenters as well as other people with whom the matter was discussed find that in viewing some of the critical elements of the pictures that not only a single stance, but any one of several stances can be assumed. At this time it is impossible to control experimentally neither the experimenters' nor the subjects' stances. What is referred to is simply that with regard to the pictures used some elements can be seen one way at one time and another way at another time. Each of the results seem equally convincing to the viewer. This is not necessarily true of all of the picture elements and it might be asked why any but the stable elements were used in the investigation. To begin with it was not known whether what seemed to be the stable elements to the experimenters would be stable to others or even to be usable elements at all; hence an exploratory group of adults was used to determine the response elements which would be common to them. It was felt that this was preferable to using the experimenter as a criterion upon which to base the investigation. It so turned out, however, that in obtaining

something somewhat common to five adults, that certain of the unstable elements were included.

General discussion and conclusions

It is obvious that the findings for the conditions used did not turn out to be very consistent from subject to subject as would have been predicted. This might cast doubt either upon the validity of the phenomena discussed by Gaffron with regard to pictures and their mirror-images or upon the ability of the age and intelligence group represented in the experimental sample or upon the manner of investigating the phenomena themselves. There seems to be no reason to doubt that the two halves of the visual field do not function alike in yielding perceptions in space, position, size, and even other features. The real problem is one of finding out whether all age groups manifest the perceptual characteristics in question. It is obvious that the sample represents a transitional age group. According to Mann and Pirie (5) there is a spurt in eyeball growth at the onset of puberty and the resulting sudden myopia is given as a reason for some of the uncertainties and awkwardnesses of boys and girls at this time in their lives. No doubt, some of the subject group had recently experienced this onset and, if so, the "uncertainties" would include any task involving visual materials. Coupled with this there seems to be a somewhat natural tendency for this age group to be a little difficult to direct and, in turn, for them to understand the directions used. It might be also, that when such subjects are confronted with

a stimulus situation in an "experimental" atmosphere they tend to adopt a different manner of behavior than in everyday situations. In the second experiment, however, they showed no hesitancy in picking a response of "left" or "right." On the other hand, further understandings are to be gained by the accumulated results of performing such experiments as this and still additional experiments. In a complex, uncharted area such as the present one, an attempt to explore the field as a whole as quickly as possible although involving considerable superficiality seems to be indicated in contrast to the attempt to solve rather restricted problems with the utmost exactness. Therefore, similar information to that obtained for this group is needed from other age groups in school and from adults. Furthermore, understanding will be advanced by success in devising a non-verbal type of response, if possible. What is meant here is not the total exclusion of verbal instructions to the subject but a kind which would merely state a problem and leave it to the subject to respond in a motor way to solve it.

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