Directional orientation in human beings

DIRECTIONAL ORIENTATION IN HUMAN BEINGS

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DIRECTIONAL ORIENTATION

in

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by

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PREFACE

A glance at recent psychological articles shows an increasing interest in the question of Orientation. They vary in content from a study of how white rats orient, to the problem of homing of birds, with an occasional reference to human beings. Scientists in France, Germany and other countries have given time and effort to the solution of the problem of "how animals find their way about." They have recognized the importance of the problem and are desirous of understanding this mystery of behavior.

What is orientation? Etymological conceptions would be to define "the position of, or arrange, in relation to the east or to the points of the compass; hence, to ascertain the bearings of," or again "to set right, as by adjusting to principles; arrange in order or so as to show the interrelation of parts or objects." Orientation in human beings is a kind of judgment, conscious or not, of the relation of objects of the environment to others and to our body. (22,178)

Orientation seems to divide itself logically into three types: Right-Left, Behavioral and Compass Orientation. The purpose of this thesis is to study these types and present laboratory methods of testing them with especial emphasis upon Right-Left and Compass Orientation.

So far as the writer can determine, no previous attempt has been made to measure the ability to orient. We believe that a better knowledge of our own methods of finding our way about will help to enlighten the general problem of orientation.

CHAPTER I

THE PROBLEM OF ORIENTATION

One of the problems which early interested the biologist and layman alike was how animals found their way about. It was observed that birds could travel many miles to reach a warmer place at which to spend the winter months but that in the spring they returned to the same locality. Later efforts by bird banding proved that some birds returned long distances to the very nests which they had inhabited the previous year. The question was, how could they do this? Did they possess some inner magnetic needle which registered as a compass? Did they possess some sixth sense which told them the way? Or did they see further and note landmarks more carefully than we could understand? The use of homing pigeons is quoted by Watson and Lashley (35) to have been found in the writings of Anacreon who was born in 550 B. C. They have been used since then in time of war and peace and until 1850 almost every army post used pigeons to carry messages. The use of microphotography enables messages of 50,000 words to be recorded on a paper weighing 0.5 gram. Even in the World War, when wireless and telegraph systems were available, some use was made of pigeons. Man has made use of an unusual ability on the part of these birds to find their way back to the cote and scientists have given various explanations of this ability.

Viguier, a French scientist, is among those who asserted that it was a magnetic sense. He maintained that terrestial magnetism was the physical force responsible and to the bird

he attributed appropriate organs to perceive the value of the magnetic actions in inclination and declination. In this way the bird when magnetic conditions were once known, would always be capable of going directly to the destination. Even if carried a considerable distance it would always be able to go directly to its point of departure. This sense would give the general direction and bring the animal to a place where the five senses could be employed. According to Viguier "terrestial magnetism induces true currents in the endolymph of the canals, the intensity of which varies with the position of these canals with respect to the directions of the needles of inclination and declination, and with the intensity of the magnetic phenomena."(33)

Others have attributed the ability to the action of atmospheric currents, wind, and so forth. Thauziès(35) made observations and tells among other things an incident occurring in 1907 when ninety-nine pigeons were released at Orleans, France. Only eleven birds came back before night. Other members of societies reported similar tardiness that day. Investigation proved that there had been severe electrical storms in the vicinity. To us this seems inconclusive but it was, however, his belief that some natural forces used by the pigeons had been disturbed.

Reynaud(28) after observation of pigeons of the movable cotes of the French army offered a very different opinion and stated a law concerning orientation of these birds which became the "loi du contrepied". This law says that

they return over the same route they have previously travelled or that they retrace their "steps". He believed that the semi-circular canals could in some way register the various turns.

In 1900 Bonnier proposed a theory that there were two possibilities of orientation. One might orient when he arrives at or when he leaves the point of departure. To do the former one must have noticed landmarks. Without landmarks, however, the second kind of orientation could be accomplished by maintaining, without recording every displacement, an awareness of the point of departure with relation to oneself. The objection I would raise to the theory would be the futility of being oriented to the point from which one is going. It is more essential to have used a similar process the entire way from home or the place to which you will later be asked to go and then on the return to establish a frame of reference including both the point of departure and more especially the goal.

In 1909 Hatchet-Couplet made experiments with travelling cotes. He found that leaving pigeons, moving the carriage, and then releasing them they could find the cote rapidly up to ten kilometers. Beyond this distance birds were lost and none returned from a distance beyond twelve kilometers. By allowing eight birds to fly thirty-five meters above the carriage upon arrival at a new place and then putting them in baskets, returns were made from one hundred kilometers. Ten birds were given the same test without observation periods and they were all lost. From these experiments Hatchet-Couplet was impressed with the effect of vision upon orientation. From the opportunity to fly above the cote he believed the

birds received a set of "visual memories." He maintained that they did not have a clear image, but rather a sense of "déja vu familier" and that the ability of a bird to see the nest by direct sight is greater than believed. As his expression for the feeling the bird has implies, he merely senses having already seen it. It seems familiar to him.

The work of Rodenback in 1895 included a test on a blind pigeon, the result of which agrees with the opinion of Hatchet-Souplet as to the importance of vision. This pigeon, which had learned by sound to reenter the cote when within hearing distance, was released in an open field within ten minutes flight by a sound bird. The pigeon flew upward without circling and then in the opposite direction from the cote. The bird never returned. If work of this kind had been continued the results might have been conclusive.

Schneider, Hodge and Duchâtel are others interested in orientation. None of these think that it is a special sense in the pigeon. Schneider concludes that if such were the case young pigeons would find their way about easily. He showed that the young if not in direct view of their homes experienced great difficulty when released, even if the distance were short. Hodge showed that young pigeons spend time flying about establishing a "system of visual landmarks" and that if they were transported in open cages they returned easily, but if transported in closed cages they made errors. He saw the importance of training in order for them to take a straight course back to the cote.

(35)

J. Watson and K. S. Lashley, working upon the problem of

the nesting behavior of the noddy and sooty terns at Bird Key, Tortugas, Florida in 1910-1913 made many observations and pointed out other experimental evidences concerning the orientation of these birds which discredited certain of these above mentioned theories. To show the impossibility of a magnetic sensibility and the reflex theories which Viguier, Theuriès, Reynaud and others had brought forth, they called attention to work of Exner who stimulated the semi-circular canals of birds on the forward journey and found that their return was hindered and many were lost. The work of Exner, however, was carried on with only a few birds and evidently poor flyers so that it does not seem correct to consider his work entirely conclusive. Among the experiments performed at Bird Key were flights of eight hundred to one thousand miles over a body of water. As they mathematically show, a bird would have to fly impossibly high and the curvature of the earth would have to be very abrupt in order for land to be seen by these birds from such a great distance. They also proved that the terns, at least, had no special tactual or olfactory mechanism by which means Cyon has announced in 1897 that birds oriented. Watson and Lashley filled the anterior nares of three noddy terns with warm wax and let it harden. Their feet were tied to prevent their scratching at the wax. Two were taken to Key West and one control bird to Loggerhead. The first two were on their nests at daybreak and the third returned thirty minutes after they had been released.

Theconclusions of these men as to proximate orientation is that it is accomplished on the basis of visual habits with kinaesthetic habits involved to a lesser extent and with no

evidence of any special sense organ. To the problem of distant orientation in animals their results are negative. We do not consider them less valuable, however, for they face the danger of explaining the problem with current theories although they "do not suggest the assumption of some new and mysterious sense."

Let us now turn to a book published in 1928--"How Animals Find Their Way About", by Etienne Rabaud.(27) This book tells of many experiments performed with various animals. We have heard so often of the "bee-line" and how the bee, having gathered sufficient nectar, knows immediately in which direction to turn and flies directly home. By Rabaud we are impressed with the fact that bees and wasps, upon leaving the nest for the first time, rise into the air, flying backwards with their eyes turned toward the nest. Evidently the insect gets the image of the nest and its surroundings. He then comes back and forth, round and round, forming what may be assumed to be sensory images. Buttel-Reepen(27;16) found that bees who had not been allowed to emerge previously, when released from forty to eighty meters from the hive were incapable of returning when a tree, house or thicket hid the way, or after twilight. Others which had been allowed to circulate about the hive experienced no difficulty. Thus quoting his own and the experiments of others Rabaud impresses one with the importance of the various senses and the absence of any special sense of direction. Just as vision is emphasized for flying insects he shows the importance of the olfactory sense in ants when moving in columns but that luminous cues become primary when the trail gives out.

The limpet uses tactile cues. Rabaud's final conclusion is that animals vary in the use of certain cues and that "all the sense organs take part simultaneously or successively in the phenomenon. All register varied images and these images are associated with one another, forming a complex in the nervous system of the animal." (27;114) For example, the nest of the animal exists for him only as a "function of the complete whole." The pigeon who has not foraged about the cote has no relation of his nest with the whole surroundings and is thus disoriented. He believes the animal tends to simplify the "complex" and take a straight line between two points." In short, the elaboration of the complex of images is such that the next site becomes connected, not in an isolated manner with one or another of the parts of the complex, but with every one of them, that is to say, with the complex in its entirety. Thus is constituted the "bee-line" or the "crow flight," which becomes ultimately more or less kinaesthetic. For visual, olfactory, or other images there is substituted the memory of a certain muscular effort, which the animal accomplishes in known territory, without the constant aid of exterior cues." (27;116) Rabaud emphasizes memory of sensory cues. He considers the process to be one of registration and elaboration with all the senses intervening in various degrees, and discredits any theory supposing another special sense of orientation.

Although we have found in these writings a few short references to it, few attempts have been made to understand the problem of orientation in human beings.

If we could understand better this process which is going on in our minds when a situation requiring this insight into the relationship of objects in our environment arises, perhaps we could better compreneend science's attempts to explain orientation in animals. This thesis shall make no attempt to study or explain the process in animals but it is the contention of the writer that we should know the process of our own mental reaction to a situation requiring orientation. Do we depend upon vision, upon hearing, a kinaesthetic sense? What is our process of orientation?

It is evident that we must decide whether or not it is a special sense. We constantly see evidences of, and ourselves experience disorientation. If we had a special sense it would seem that people would experience much less difficulty in finding their way about. We shall make a study in a later chapter of the experiences of some one hundred subjects.

It is quite evident from our everyday experiences that we do not use a special sense of direction. Thus in walking through a wooded section, entering a strange city or taking several turns when driving an automobile we may experience disorientation. We have to recall the turns by means of certain cues. For example, we may employ visual memory, or perhaps find a landmark such as a hill by which we can visualise the relationship of our present location with our own home, where we left our automobile or some such goal.

You may ask if such a sense may have existed but has generated from disuse. H. R. DeSilva in an article in Science[9] told of a boy with an exceptional ability to give

the correct compass points in any normal situation but who was completely disoriented when blindfolded and rotated. He did not possess any one sense which gave him the correct response. Here is an example of a person who orients exceptionally well but when vision is cut off and he is rotated becomes completely disoriented. We, too, often become confused. We are not able, in the case of most individuals, to stop and immediately point to North. This seems to be a difficult process for us. We do, however, find exceptional people who seem better able to do this than others but even these people rely on the ordinary senses.

When we stop to analyze and compare the process in several individuals we soon see that it is naturally the person who is quickly able to find his relation with things outside himself, who is well oriented. It is whether or not you experience that unpleasant and annoying sense of being lost or turned about for a shorter or longer period of time which shows your inability to orient. This feeling of being disoriented is psychologically important. We do not enjoy the sensation of being "lost." We like new situations and places but we like to know where we are in relation to known things. Some people are more interested in this relationship than others, and some situations demand it more than others.

Some people do not care where they are in regard to large areas. They are quite content if they do not know that Boston is East of them or that they take the left hand fork to go to New York. It is often unnecessary in our

present day of sign boards and route numbers to be oriented in these terms. If there were no such directions, however, and we needed to keep some kind of bearing in order not to proceed at a ninety degree angle and travel some extra fifteen miles out of our way, then we might be a little more concerned. Or suppose we lived in a thickly wooded section and hunted our own game. Following trails and beating through woods we might be more perturbed if we had lost our awareness of the relation of our present position with outside and known things.

There are situations such as finding oneself about in a new city, in which one can become completely disoriented. If any one has experienced those few panicky seconds of being lost, one knows how unpleasant it is. I remember, as a child, when I was too young to immediately think of asking some one the way, as our dislike of the sensation teaches us to do, I experienced such an unpleasant feeling. I was separated from my family at an intersection in what then seemed to me to be a large city. I was probably then only four years old, but I still remember the incident. It left an indelible impression of the most unpleasant kind to see people go by, to see strange stores which all looked alike to me, to see several streets down which I might go, and above all, to be just lost. My mother would tell that it was only while a few people passed between us. It was a matter of seconds but it seemed minutes, and the memory has lasted through years. People lost in the woods will tell

of similar feelings. This emotional upset is probably detrimental to the human being's using the cues he may have as to his whereabouts.

A study of the problems of which people have written and observation convinces us that there are three types of orientation. First there is Right-Left Orientation in which we place something in relation to ourselves. We turn to the right, look for a book on our left, always thinking in terms of the way we are facing. This of course varies with our position and offers problems in orientation. Suppose that you are a physical education director and are giving commands to a beginners' class. You say, "right face," and to facilitate their turning you immediately face left. Perhaps by now it has merely become a substitution of right for left but at one time you had to imagine yourself facing the direction in which the class was facing and decide the way in which you wanted them to face. In other words, you oriented yourself. Some people seem to have greater facility than others in this Right-Left Orientation and this thesis will attempt to show and measure this ability.

Another type of orientation and one which has seemed to command the attention of the observers is what I shall call Behavioral Orientation. This is a method using the relation to some goal. It is the common situation in other vertebrate life. The animal is oriented in regard to his nest or burrow. He may wander afield but he can, in the case of a good many animals, take a more direct route home without retracing his

path. This ability is probably surrounded with more mystery than any other. Human beings in some situations have very little need for or chance to develop this type of orientation to any extent. People, however, seem to vary in their ability. One person upon going to a new city, having perhaps been driven to his office, will have little difficulty in getting home. Of course, he can not take a direct route in a city district, but he will have observed that he came from a certain direction toward his office building. The person with good orientation will have noticed about how far he came. I do not mean in miles but by an awareness of movement and an estimate of time he will be able to approximate the distance. He may not even follow the route over which he was brought the first time, but he realizes the general direction in which he is to go. Soon he may recognize a familiar corner drug store or a church he knows to be in his neighborhood and from which he orients and finds home. Now we can readily see that in human beings vision, relative fatigue, passage of time, sense of movement, observation, and memory of details are important to orientation of this type.

From an unfamiliarity with this process or a lack of faith in it the reader may realize that we do not develop this ability to the fullest extent. Some writers contend that we have lost it. Comparison with animals readily shows their superiority in this respect. Incidents showing the ability of uncivilized people impress us with our inferiority. We must remember, too, that the uncivilized person has more time to explore and

get to know his immediate environment. He gradually goes far afield and becomes familiar with wider territory. He travels on foot for the most part and this slow method gives more opportunity for observation; his very livelihood demands that he hunt in the dense sections which make it essential for him to maintain some frame of reference. This type of orientation seems to be a method in which the able subject keeps in mind, perhaps subconsciously, the relation of himself with some fixed goal. It may be true that the more subconscious we keep the process and the less we try to reason out and remember every single step to be taken the more successful we may be.

Notice tales of trappers and hikers and we find that memory is very important in their orientation. Jim Bailey, a trapper, when writing about an experience of being lost says, "For five hours I plodded, wallowing on. Then, without warning, I was in my own country. I recognized a clump of spruces in which I had killed a deer one time. Just beyond I saw a blaze on a tree, an old trap line I had run fifteen years before away back, east of the West Canada Lakes. In two hours I was in one of my trap-line cabins with a fire going and something to eat." (30) This also shows his familiarity and experience with a large territory, as well as a remarkable memory. The clump of spruce, the blazes, were as significant as the corner drug store. They had association for him.

The third type of orientation which I wish to discuss is Compass Orientation. We have said that uncivilized people

probably use Behavioral Orientation. It is also interesting to note that certain savages in Madagascar have no words for right and left. Their orientation is probably a composite of these last two types. Whereas, Right-Left Orientation varies with the direction in which one is facing, this last type, Compass Orientation has a constant or fixed frame of reference. It facilitates the giving of direction and is a means of easier communication with others in regard to position. Because of the necessity of a compass, some notation as to the direction of some landmark, or some other source of information, most people in this section of the country do not learn to orient this way. People, because of training and habit and awareness of the lack of training on the part of others, think it easier to give a series of right-left directions rather than the compass direction.

This type of orientation is quite easy to understand. We have the conventional nomenclature of North, East, South, and West for given points. We may find one of these by the use of a compass or more advantageously by certain fairly constant facts of nature. People orient most often by the sun and the North Star. Having found some point it is necessary to orient from that to find other relationships with one's surroundings. People do this differently. Some people see the surrounding territory as if from above and put North at the top. Some people see a map and others say they place a large conventional compass design around themselves. Many

problems occur in Compass Orientation. For example, some one travelling from North to South may attempt to find his location on a map. If he were going from South to North it would be quite simple but in this case he may feel as if he were standing on his head. Some find it easier than others. They are able to read the map readily and gain from it the desired information. Others find it quite difficult.

Regardless of evidences of individual differences in both Right-Left and Compass Orientation no previous attempt has been made to measure this facility. As has been pointed out, it is a comparatively quicker thing for some people to "turn themselves about mentally" than other people. We have suggested also, that the ability might be more useful if automatic. Our problem in testing then will be to get the comparative results, with the individual's reaction to situations requiring no orientation discredited, of responses to type situation in which orientation is necessary.

CHAPTER II

FACTORS IN ORIENTATION

In order to obtain information concerning the way in which people orient and factors influencing the process a series of questions were asked one hundred five subjects concerning their ability to orient and the cues which they used. These questions enquired about various environmental factors, methods of orientation and experiences which we thought might in some way influence the problem.

This is the series of questions.

1. Is it easy or difficult for you to orient yourself directionally?

2. Which is easier for you, to think in terms of right and left or compass directions?

3. What explanation can you give for this preference?

4. In your home has it been customary to use points of the compass in giving directions? Do you ever use compass directions? How?

5. Are you right handed, left handed and / or ambi-dextrous?

6. Which is your aiming eye?

7. Looking from above does your hair grow in a clockwise or counter clockwise whorl?

8. What cues aid you in orienting yourself to compass directions?

9. Do you customarily orient from the E. S. N. or W? Have you ever changed your habit in this respect?

10. What direction does your house face?

11. Do you often use the direction of a familiar street or road in orienting yourself?

12. Do you orient by the sun?

13. Do you orient by some landmark such as a steeple, tall building or hill which you know to be in a given direction? If so what is it? What direction is it?

14. Can you orient yourself on a map when the top does not indicate north? If so what cues do you use?

15. While playing checkers or chess can you and have you ever visualized the board from your opponents position?

16. Is either of your parents left handed or ambidextrous? Is either parent very quick at orienting him - or herself to either right-left or compass directions?

17. Have you ever as a guide or hotel clerk, etc., had to accustom yourself to giving directions? If so, did it aid your orientation? In what way?

18. Have you ever been disoriented upon entering a city for the first time? What caused this disorientation? How did you overcome it?

19. Do you live in a rural or urban district?

20. Are you generally interested in "getting your bearings" or has it never seemed important to you?

21. Have you observed any other peculiarity or interesting fact about your sense of orientation? Are any of your acquaintances exceptionally good or poor at either right-left or compass orientation? If so, are there any comments you can make about them?

Let us now examine the results.

PREFERRED TYPE OF DIRECTIONAL ORIENTATION

	No.	Per cent
Right-Left	72	68.5%
Compass	24	22.8%
Either	9	8.5%

Various reasons were given for preference, the most common answer being that they could merely consider it a matter of habit and constant usage. Others found various bases for their choice. They can be summarized as follows:

10 Learned this method first.

31 More common usage therefore directions given are more easily comprehended.

3 Compass directions were never used at home.

2 Lived in city where thought in terms of streets, and neither knew where any compass point was nor was able to see sun and stars.

5 Have to stop and find some point and then find direction in which going. Find it difficult.

1 Was daughter of woman who had difficulty with Right-Left and therefore encouraged to practice and use a great deal.

3 Never used sun nor knew stars and therefore lacked point from which to readily orient.

2 Think of themselves in a given position and therefore give right or left of themselves.

2 Are decidedly right handed and think "the hand and not the hand."

1 Obeying military commands made him think in terms of right-left.

2 Prefer to think this way concerning small areas but for large areas use compass terms.

2 In driving car have come to think of turning right or left from road on which traveling.

1 Made conscious of right and left because is really left handed but trained to use right.

1 Has no confidence in ability to tell compass points.

6 Did not express an explanation.

We see that there are various points made here. It is quite evident that our every day practices, contacts with others and training encourages the use of Right-Left Orientation.

There were those, however, who found that certain things had encouraged their using Compass Orientation.

2 Live in the country where sun and stars are closely observed.

1 Surveying.

1 Studying landscape architecture.

1 Living in the West where directions are more often given in Compass terms.

3 Studying geography and maps.

2 Being brought up with people who used Compass directions in the home.

2 Hiking, hunting, etc., which made it necessary to find his way about. Found it necessary to notice sun, stars and so forth.

1 Yachting.

1 Always interested in a wall map which hung in the home.

1 Had difficulty determining the right or left hand.

3 Used it as a matter of habit.

2 Watched the position of the sun.

5 Did not offer an explanation.

Some said that they found it much simpler to use Compass Orientation. It is doubtless true that the absolute points would be easy for us if we were accustomed to them. In giving directions and following them it would be much simpler to be instructed to bring a book from the Northwest corner of a certain room than to be told to go into the room and face left then to look in the right hand corner. There are more directions to remember and it is much harder to give these directions. If people would notice some cue as to North, South, East or West and make it a practice to be compassly oriented this method would probably prove much simpler.

To answer a question concerning a possible influence of the home upon the lack of use of Compass Orientation we questioned the use of compass directions in the home. Out of one hundred and five homes only thirty-four used them. Fifty-four never did and seventeen only gave directions or oriented by this means occasionally.

USE OF COMPASS DIRECTIONS IN THE HOME

Number		Per Cent
Yes	34	32.7%
No	57	54.8%
Occasionally	17	16.3%
	104	

SUBJECTS USING COMPASS DIRECTIONS		
Yes	50	52.0%
No	28	29.1%
Occasionally	18	18.4%
	96	

Not having to interpret and utilize compass directions at home probably gives one reason for a preference for Right-Left Orientation. To encourage Compass Orientation, however, such training as given in Boy Scouts, Girl Scouts, surveying courses and architecture as well as life situations demanding the use of compass points were mentioned by some sixty-eight people who said they themselves did use compass directions to varying degrees. People also mentioned that living in the country one was more inclined to be compassly oriented. A study of this proved that more rural people preferred Compass Orientation than city people did. Although our results did not show a wide margin we believe that this is a fair statement. Probably our results were not more conclusive because many of the subjects spent summers in the country and because the M. S. C. campus, their present environment, is situated in a rural community.

The most common compass point from which to orient was North. We can see from the table following that the preference is a decided one.

PREFERRED ORIENTATION POINT

	No.	Per Cent
North	58	56.7%
East	22	21.5%
South	3	2.9%
West	8	7.8%
No Preference	11	10.7%

This is doubtless due to our familiarity with maps. We tend to make a frame of reference with North at the top. Another reason might be the use of the North Star by which many said they oriented at night. Others mentioned the use of the growth of moss on the north side of tree trunks by which they had learned to orient. The use of East and West is easily understood by the frequent references made to the sun. Fifty-seven and one tenth percent of the responses to a question as to whether or not the subject used the sun by which to orient were "Yes."

Another method used was to remember the direction of a familiar street. Seventy-seven and one-tenth percent said that they utilized this method, and seven and six-tenths per cent only did this "occasionally." Other means of finding some compass point were the use of a steeple or tower, hills, buildings, rivers, moon, the ocean, sunset, the names of near-by towns such as East Brookfield, West Springfield and remembering the location of one's house or how one faces when working at his desk. A study was made of the correlation of the direction in which one's house faces and the preferred orientation point. It showed that only about twenty per

cent oriented from the point to which his house faced. This is not a very large per cent and leads one to believe that this influences a few individuals but is not general. The most important influences seem to be the familiarity with maps and the use of the sun.

Some people said that they experienced greater facility with maps than others. Sixty-two and eight-tenths per cent of the subjects expressed the opinion that they were able to read a map placed so that North was not at the top. The method in general was to find two familiar towns roads, landmarks, bodies of water or some line such as the coast line from which to determine a North, South or East, West direction. All stressed the importance of having something familiar for a cue. One person mentioned that the capital letter of a town name, if given, would in the majority of cases be West. Some people then imagine the map twisted around but more people read it as it is, imagining themselves turned around. Some experience so much difficulty that they actually have to turn the map around with North at the top. If you watch people reading maps you will notice a tendency to do this or else twist the head. The ability to mentally turn oneself around was shown in a previous chapter to be significant as a process in orientation. As we saw then, it varies with the individual.

Of the group of subjects, twenty-seven had experiences as hotel clerks, guides and so an which most of them thought had improved their orientation. Several mentioned that it had necessitated their noticing the directions they were taking, the relation of certain buildings and streets and

the location of the compass points, their remembering the landmarks, turns and so on and their visualizing a picture of the vicinity. Some mentioned that the frequency of giving right and left directions helped them determine right and left much more quickly. One or two felt that it had not improved their ability. One said that it confused him because he was accustomed to think in terms of compass directions but he had to give them to others as right and left. This seemed exceptional, however.

We mentioned in Chapter I that people disliked the sensation of being disoriented and were usually interested in knowing where they were. We presented this question to our one hundred and five subjects and found that seventy-three were generally interested, twenty-six were not and that six were interested at times. A study of the comparative interest of people living in urban or rural districts shows that of the former eighty-two and five tenths per cent are interested in "getting their bearings" while only sixty-four per cent of the city folk consider it important.

Earlier in this thesis the statement was made that the frequency with which human beings become disoriented makes it impossible to believe that they possess a special sense which can determine the direction in which they are going. This questionnaire shows that of the one hundred and five subjects only eleven had not experienced disorientation upon going to a strange city. Eighty-nine and five-tenths per cent had been disoriented. I am going to quote a few of the answers:

1. "Streets were not laid out according to the mental image first formed. By standing still, accustoming myself and getting located I overcame it. I have also been disoriented because of a different point of entrance."
2. "It was caused by a great number of curves and corners, as one enters the city. By going over it in my mind I got the correct orientation in mind."
3. "In Lawrence, Kansas, the train brought me from Chicago (North) into town around a bend of the river thus entering from the South. I always thought of Chicago to the South. I never overcame the feeling although I always quickly swung my frame of reference around when I become critical of it and thought of driving somewhere."
4. "An arm of the Buzzards Bay cut back inland, and seemed east. It was really North. This disoriented me but by watching the sun, and studying a map of the city I overcame it."
5. "Recently I went to Troy, entering the city after dark. The next morning a group of us went for a walk. After going around a few blocks we could not get back to the hotel. This was because we entered the city blindly and didn't know which way our hotel faced or other valuable cues."
6. "I have been disoriented several times. This was caused by riding in an irregular route without paying any attention to definite directions. I

overcame this by entering the main street and discovering its general direction. Thus I was able to determine from which direction I had come."

7. "I failed to keep notice at first of general directions and buildings obscured the general skyline. Stopping to think I was able to orient myself."

8. "So much that is new often gets one confused, and you can't tell just where you are going. I overcame it by establishing myself in one place and taking further directions from that place."

There are many interesting things to be seen in these answers. We can see that it is common for people to visualize or form a picture of a given section. When there are many turnings and curves we often lose the correct picture of ourselves in relation to our environment and the relation of the various objects in the environment. We then endeavor to reestablish this picture. Some mentioned that they "stopped to think" or they went over it in their minds or swung their spatial frame around. We remember that it was this facility which we considered so important in orientation. Some mentioned that the difficulty arose because they had either failed to notice surroundings or in some cases had entered the city at night or while asleep on the train. One subject said that he did not see a sunset, by which means he had customarily oriented, for two weeks and was so disoriented that he never seemed to be able to overcome his disorientation completely except when he actually stopped and figured it out. This shows the importance of vision.

It is also true that some cities are particularly confusing. Among them we can't fail to mention Boston. Many subjects mentioned this. Cities which are more simply planned are much easier to visualize and we therefore form a spatial frame of reference much more readily.

It is evident through out this questionnaire that subjects recognized the importance of memory, observation and the use of all five senses in being well oriented. These we believe to be essential. By these means people tend to establish a mental picture, in some cases much less consciously than others, which is the relation of the individual with his environment and the relation of the component parts of his surroundings. Three types of orientation may be used (1) Right-Left (2) Behavioral (3) Compass. We have proved as a result of this questionnaire several facts relative to the first and third types.

1. Right-left Orientation is more commonly used.

2. In one hundred and five homes only thirty-two per cent used compass directions to any extent.

3. A higher per cent of rural people, however, used compass directions than did urban people.

4. The majority of people orient from the North. East is second highest.

5. Sixty-two and eight-tenths per cent of the subjects could use a map when North was not at the top.

6. Giving directions a great deal encourages one to be observing.

7. Seventy-three per cent were generally interested in being oriented.

8. Rural people are more interested than urban people in the problem of orientation.

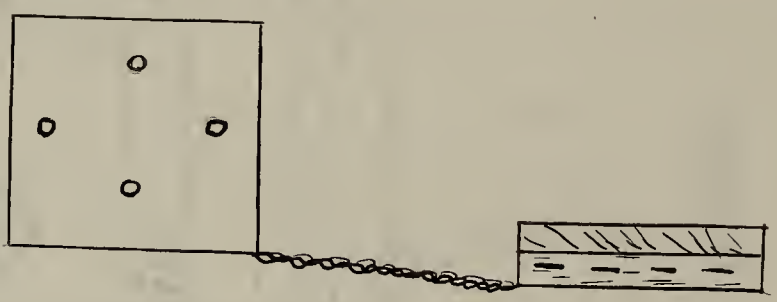
9. To keep from being disoriented one needs to be observing and able to get sensory cues.

CHAPTER III

MEASUREMENT OF RIGHT-LEFT AND COMPASS ORIENTATION

From the study of the factors in orientation we see the tendency to use Right-Left orientation more than Compass. The next problem is to check these assumptions made in the questionnaire. To accomplish this problem of measurement it was necessary to devise some apparatus which would present a situation to which the subject would orient, and which would indicate the subject's time of reaction.

The observer faces a panel (8" x 8") on which are placed, as illustrated below, four lights. Four touch keys are conveniently located in front.



In back of the panel are electric switches for exposing any two successive lights. There are two groups of switches. Any one of one group of switches selects the first light, and any one of the other group selects the second light. By means of a rotating contact time delay outfit the interval between the lights remains uniform.[1] With the flash of the second

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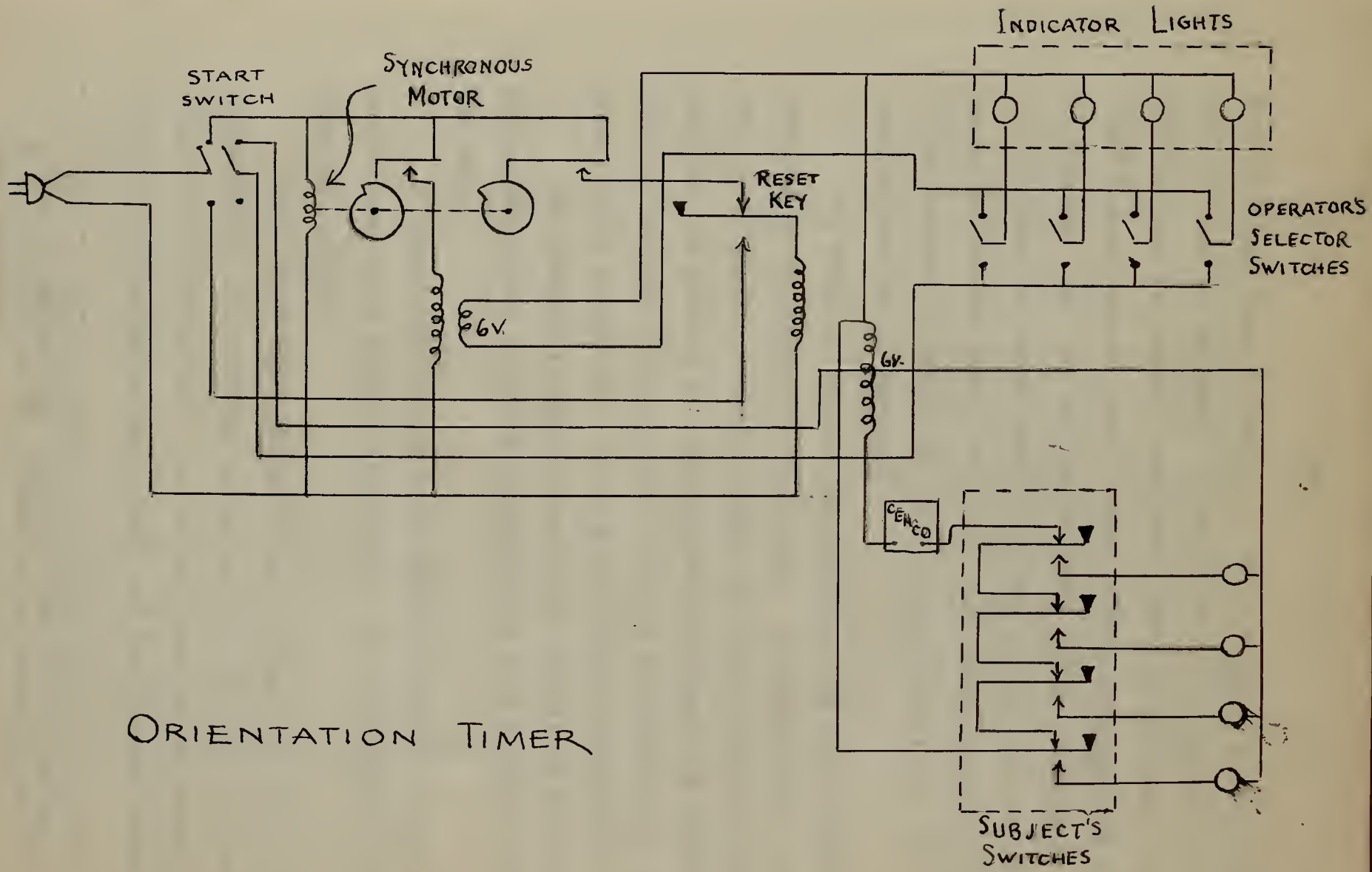
1. See diagram on next page.



ORIENTATION TIMER

light a Cenco Timer is started. It is stopped by the subject's pressing one of the keys. In order for the examiner to see if the response is correct there are in back of the panel four small lights, one of which flashes as the corresponding key is pressed. The time is then recorded by the examiner.[1]

There are three tests given the subject and eighteen reactions in each test. The first test measures the facility of the subject to orient in terms of right and left. The instructions are as follows:

"In front of you are four lights. You are to picture yourself at the center of this panel. Two lights will flash. You are to imagine yourself facing the first light and tell by pressing the correct key in this series whether the second light is to your right, to your left, or in back of you. The keys will be marked left, in back and right respectively."

The subject is first given three situations in order to become acquainted with the procedure and then continues with the test.

A second test is one which shows ability to "turn oneself about" when using compass directions. The directions are first given as follows.

"The first light which flashes in this test will be North, regardless of its position on the board. You are to give, by means of the correct key, the compass point of the second light. The keys will be North, East, South and West respectively."

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1. I wish to acknowledge the work of Dr. H. R. DeSilva, R. S. Prescott and B. Wellman in the construction of this apparatus.

After giving the subject three chances to try this, the examiner then proceeds and records the time necessary for each response.

The third test also involves compass orientation. Instructions are given as below.

"This time you are to assume that the first light is East. You then give the compass point of the second light which flashes. The keys will be marked as in Test No. 2."

As in previous tests the responses are recorded by the examiner.

These tests have been given at the Massachusetts State College to ninety students at the winter and summer sessions. The results are interesting and worthy of our present attention.

First we can justifiably ask if our apparatus actually tests ability in Right-Left and Compass Orientation. We asked the subjects whether in their experience they had found orientation easy or difficult. The people who thought it easy had better or lower average than those who found it difficult.

	Easy	Difficult
Test #1	.77 seconds	.81 seconds
Test #2	1.08 seconds	1.28 seconds
Test #3	1.48 seconds	1.60 seconds

Another proof is the fact that those who said that they customarily oriented from the North did better on Test No. 2, which requires orientation from this point, than people who usually oriented from the East. The latter, however, did better on Test No. 3 which necessitates orientation from the East.

	N. oriented	E. oriented
Test #2	1.19 seconds	1.22 seconds
Test #3	1.44 seconds	1.38 seconds

Still another proof lies in the comparison of the results of Right-Left (Test No. 1) and Compass (#2 and #3) Tests. The people who customarily use Right-Left had a better average on Test No. 1, while those who used Compass orientation had better averages on No. 2 and No. 3.

	Used R-L	Used Comp.
Test #1	.70	.88
Test #2	1.16	1.14
Test #3	1.59	1.29

We see from this that there is a correlation between the actual experience of the subject and the results obtained with this apparatus. It also shows the importance of usage or practice in orientation. One of the reasons some people find it easier to orient by a certain method is that they have had occasion to use it more than others.

The comparative abilities of various groups are interesting. The score in seconds for each subject was determined by subtracting from the average of his responses in a given test the average of the responses to the simplest stimulation given. This stimulation, given twice in the first test was to face the North light and determine the south light as being "in back of him." This response is a fairly good indication of reaction time without actually "turning oneself about".

There is a wide range of ability, as indicated by our results.

	Lowest Score	Medium Score	Highest Score
Test #1	.11	.59	1.99
Test #2	.08	.87	3.48
Test #3	.11	1.18	4.25

In the mediums and the high scores we see the relative difficulty for the subjects in these three types of situations requiring orientation. It probably does not show in the very low scores because they are exceptional cases.

To better see the relative difficulty the averages were determined for each test. They were as follows for the ninety people observed:

Test No. 1 -- .73
Test No. 2 -- 1.15
Test No. 3 -- 1.52

This shows that Right-Left is easiest, North orientation is next, and East is most difficult of these three.

Even more conclusive are a series of studies of the individual records of these ninety people

65% found Right-Left Orientation easiest
22% found Orientation from the North easiest
10% found Orientation from the East easiest
1% found Right-Left and East equally easy and North difficult

12% found Right-Left Orientation most difficult
32% found Orientation from the North most difficult
55% found Orientation from the East most difficult

Another means of seeing the relative difficulty of these three methods of directional orientation is to study the errors made. In Test No. 1 there were only 91 errors, Test No. 2 had 93 errors in all, and in Test No. 3 there were 113 errors. This shows that Right-Left Orientation is easier for this group of subjects and that North Orientation gives less difficulty in Compass Orientation.

When we divide the cases according to handedness we have an interesting indication. All evidence has led us to see the fairly constant comparative facility of Right-Left Orientation over Compass Orientation and the comparative difficulty of orienting from the east as compared to the north. The scores of decidedly right-handed and left-handed people showed these same relationships. The scores of ambidextrous people did not, however. The following figures bear out this statement:

Right-Handed People (67)

67% found Right-Left easiest
23% found Orientation from North easiest
10% found Orientation from East easiest

10% found Right-Left most difficult
33% found Orientation from North most difficult
57% found Orientation from East most difficult

Left-Handed People (11)

83% found Right-Left easiest
16% found Orientation from North easiest
0% found Orientation from East easiest

0% found Right-Left most difficult
33% found Orientation from North most difficult
66% found Orientation from East most difficult

Ambidextrous People (12)

57% found Right-Left easiest
14% found Orientation from North easiest
33% found Orientation from East easiest

33% found Right-Left most difficult
33% found Orientation from North most difficult
42% found Orientation from East most difficult

First note how the ambidextrous group falls out of line with the fairly constant relationship of the left and right handed scores. We find that here the largest percentage of any group had difficulty with Right-Left Orientation and while

orientation from the north was average these subjects found orientation from the east easiest in a larger percentage of cases than either of the other two groups. They also had the smallest per cent of people who found the orientation from the east most difficult. Now let us compare the scores of the three different situations in the ambidextrous group. It is surprising, after the above statements, to find that 57% the largest per cent, found Right-Left easiest. Notice, however, the increasing ability in Compass Orientation. I feel it justifiable to say that ambidextrous people surpass the decidedly right or left handed people in ability to use Compass Orientation. This is probably due to the uncertainty of the individual as to which is the right or left if one does not predominantly use one hand. This doubt in the use of relative orientation leads to the use of absolute orientation which we have shown to be compass orientation.

An interesting indication of the tendency of most people in this section of the country to underestimate their ability at Compass Orientation, probably due to our more common use of Right-Left directions, is shown in the following data. Of the twelve who did best in Orientation from the North, seven would have predicted that they would have done the first test best. Likewise in Test No. 3, three of the five thought they were better in Right-Left. In other words ten of the seventeen who found Compass Orientation easiest on the test had been using Right-Left Orientation. It would certainly seem that these people would orient in everyday situations much more readily

if they thought in terms of Compass directions. It shows that some of us are unaware of our ability to use Compass Orientation.

From this experiment we can conclude several important things.

1. Orientation can be measured

2. The average ability for people in this vicinity using this method of scoring is:

Right-Left	
Test #1	.73 seconds
Orient. from North	
Test #2	1.15 seconds
Orient. from East	
Test #3	1.52 seconds

3. Right-Left Orientation is easier for most people than Compass Orientation.

4. Orientation from the North gave less difficulty in Compass Orientation.

5. People who experienced difficulty in orientation in life situations had poorer scores on this test.

6. People who customarily used North by which to orient had better scores on the test requiring this method.

7. People who used East by which to orient had less difficulty with the test requiring orientation from this point than did those who customarily used North.

8. People who used Right-Left had better scores on Test #1 while people using Compass had better scores on Tests #2 and #3.

9. More errors were made on the test requiring orientation from the East, whereas, the least were made in Right-Left orientation.

10. People who are ambidextrous show a superior ability in Compass Orientation.

Here we have the results of this study of the Right Left and Compass Orientation of ninety people. Some were right handed, some were left handed and some were ambidextrous.

These three different types had their own problems. The right handed and left handed people seem to have similar results. I feel that the superior ability of ambidextrous people in compass orientation was due to their effort to establish relationships by some means outside of themselves. Compass orientation is an absolute thing. The ambidextrous people expressed having a feeling of hesitancy about determining which was right or left due to the ability to use both hands. It would be natural to try to maintain a feeling of security by utilizing some absolute means of orientation.

There were problems in the testing which will doubtless demand attention as the use of the apparatus is continued. Some may question which people should be called ambidextrous. We used people who could do several things with each hand. There are degrees of ambidextrousness. If the person could only tie his tie with the left hand, for example, that person was classed as right handed. However, if a person could bat a ball with either hand or, write with left hand and sew with the right or vice versa, we called the person ambidextrous. Another problem was the problem of errors. The subject was told to cooperate by getting the correct answer and then pressing the key. It was natural to find a few errors. Most of them were discovered almost instantaneously with the pressure of the key. Each error was checked and if a person made more than two or three errors on a test his results were not used. A study of these showed that the averages would not have changed the results. If anyone were interested in using this to standardize the results and set up a devise to get

individual ratings, this problem would have to be overcome. I personally feel there is no need for such a study. The broader study of this thesis concerning the ability of human beings as a group to orient is much more valuable. From these tests we have been interested in learning about the abilities of different groups and some of the influences upon orientation. These I consider important.

CHAPTER III

BEHAVIORAL ORIENTATION

The remaining type of orientation, although it was not the intention of the writer to study this method as thoroughly as the other two, should not be entirely omitted from this thesis. It is a common method and one of the most useful. In a previous chapter we have defined for the reader what we consider to be Behavioral Orientation. It is essentially the ability to bear in mind the relation of oneself and one's goal. We cited the illustration of a man's returning to his new home from the office to which he had been taken by automobile that morning. The person who could do this easily we maintained had noticed visual cues, had a good memory for detail, had an approximate estimation of the distance he would have to cover and the time it would take, and an idea of the general direction in which he was to proceed. In other words he perceives certain relationships between himself and his environment.

In order to observe this kind of orientation it was necessary to present some situation which would necessitate the subjects moving about in an area and then giving the relation of himself to a given goal. The subject was taken to a tree in the center of a level field and told to face a given landmark so that he would be well oriented at the point of departure. He was next blindfolded. The examiner then led him over a course or route which consisted of a

series of ninety degree angle turns. The subject must be led about or he would tend to spiral as A. A. Shaeffer and Lund have definitely shown. If the subject took curved lines and short angles it would be impossible for him to have any basis for relationship unless there is a special sense of direction in human beings, which theory the writer does not indorse. We have observed from the experiences in life situations which people have related that when streets or roads curved gradually they found themselves disoriented. Orientation in this case would be just chance unless the curve is noticeable enough for the person to observe it and allow for it. Because vision is cut off in this test it is necessary to make all angles ninety degree turns (or some other known turning) and keep the person in a straight course.

The route should be fairly long. After one or two turns the person can almost always tell you the direction to his point of departure. There were seven to twelve turns. Then the subject was asked to point to the tree. The angle of deviation was recorded and the subject was asked to go the distance necessary to be at the foot of the tree. The examiner citing the direction in which the person had pointed led him in a straight line until the latter said he should be at his point of departure.

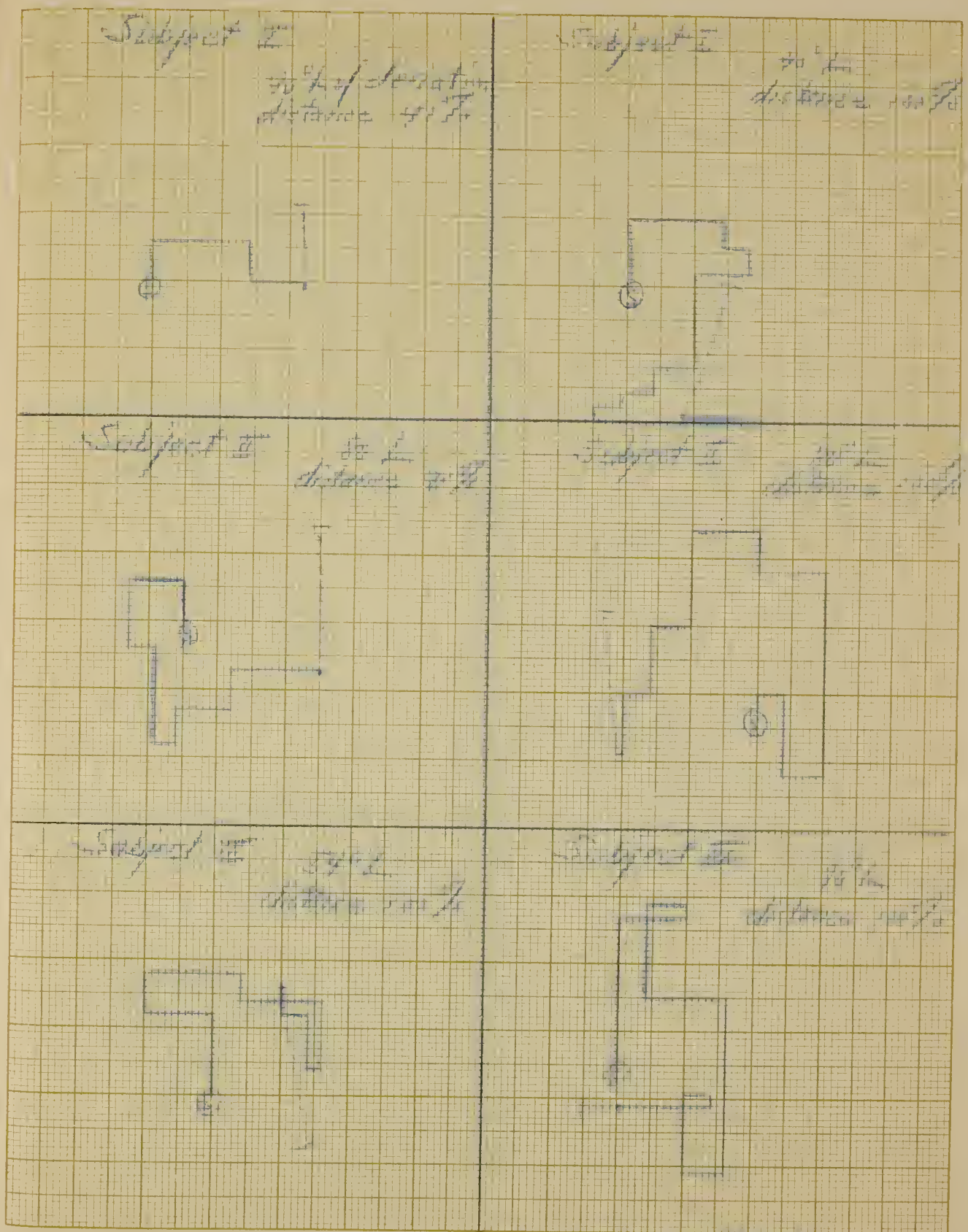
This test supplemented with any suggestions the examiner could gain regarding the method the subject used to "keep his bearings" gave a good picture of the process of Behavioral Orientation.

On the following charts we shall show the routes traced, the angles of deviation and the judgments of distance of some of the subjects.

The purpose of this brief introductory procedure was not to formulate any statements regarding people's abilities to perform this type of orientation but rather to gather from their introspection material concerning the method or means used to orient. There are some interesting points found in the data obtained and we should not fail to note them. The results are as follows:

Angle of deviation	Distance
0°	80%
40°	100%
45°	140%
54°	100%
56°	140%
80°	91%
80°	100%
90°	100%
90°	41%
180°	100%
180°	166%
180°	200%

It is quite evident that the first subject was correct in direction and good in distance. The last one would have gone in directly the opposite direction and twice as far as necessary. It is interesting that such examples should lead and close our list. Notice all of



the cases having 100% distance, however, and you will find that the angles of deviation are 40°, 54°, 80°, 90°, and 100°. So our present results show almost no correlation.

As the subjects took the test they were questioned concerning their method of orientation and asked to tell what things influenced them. Vision, kinaesthetic and auditory cues with observation and memory of these all seemed important.

First let us discuss the importance of vision in this type of orientation. The angles of deviation show that there were many errors on the part of these subjects. Taking the test one is immediately impressed with the handicap one has when vision is cut off. More than we realize, we are continually taking in, consciously or not, certain objects before us. A series of these cues may be for an individual all he needs to go from one point to another. One person tells of an experience of being lost on his way home from his first day at school. Some kind individual straightening out his confused thoughts took him to the front of the schoolhouse and pointing to a tower said, "Go that way to find home." For many years after he never turned down the end of the walk without glancing at the tower. It was a visual cue which he had become accustomed to use and even after he knew the way he still glanced at the tower. We use visual means then of establishing a relationship between ourselves and our environment. To have a knowledge of that relationship is to have a feeling of security and be well oriented.

Memory is another factor. The subjects in the above test attempted to remember certain displacements they had made. They were not successful if they attempted to remember all, however. The better way was to remember just the previous displacement and establish the new position. In an ordinary situation visual cues and auditory cues would be remembered. Auditory cues became more valuable to the subject when visual stimuli were absent. These cues should also be mentioned as another method of finding relationship with one's environment. Tales of hikers and hunters will bear this out in their notation of sounds of running water. Memory is also important in judging the distance. We see here that a general memory of the vicinity, utilizing all cues, is necessary to the maximum ability in this orientation.

There seem to be two general methods of maintaining relationships in this simple test and they are probably general to this type of orientation. One method is to allow for the displacement each time and then maintain the relationship of oneself to the tree. Another method is to allow for the displacement and then see oneself as facing a certain way in the frame you are setting up. Then when asked where the tree is one determines the relation of himself to the tree in this frame of reference. In other words, the first is a relative orientation and the second is absolute.

The last step in this test gives us information concerning the individual's ability to judge the movements he has made as well as the distance and the time necessary to traverse a

direct route to his goal. This is indeed important in a situation demanding this type of orientation. To be able to estimate how many blocks one should go in one direction before turning down a side street, if orienting in the city, or about how many miles one should go in a certain direction if traveling by automobile, are all important. Some people who had actual direction wrong could approximate about how far out they had gone very accurately. Others went in the right direction but would not have gone far enough.

So we see that there are various cues which can be utilized by human beings in the process of orientation. Visual and kinaesthetic are the most important with auditory of occasional aid. Memory is also important as is the ability to allow quickly and preferably subconsciously for displacements and establish the relationship of oneself to one's environment.

We have said that Behavioral Orientation may be either Relative or Absolute. Right-Left is always the former and Compass is always absolute. It is the contention of the writer that in the "evolution" of orientation the process to which this chapter is devoted is the simplest method and is that used by animals and savages to find their way about. Right-Left and Compass Orientation are the methods established by man to express and make more uniform the processes of relative and absolute orientation. As has been mentioned before, the people of Madagascar do not have words for right and left. It is also true that people of Hawaii do not have words for east,

north, etc., but use the sun, moon and stars by which to express to others absolute directions. Our everyday use of words such as right, east, etc., has come about as a desire to express to others the relation of objects in our environment. So we see that Behavioral Orientation is a simple method and is the relation of oneself to his goal.

SUMMARY

We conclude this paper with the following statements:

Human beings do not use a special sense of direction. They have rather an ability to allow for displacements made along their route. If these are not decided enough to be observed human beings cannot detect them. Visual cues and the sense of equilibrium aid in this. Man orients by the use of memory, observation and the five senses.

Directional Orientation we have divided into three types: Right-Left, Behavorial and Compass. The first and third we have succeeded in measuring. Right-Left is a relative orientation while Compass is absolute. Behavorial Orientation may be either.

In our study of Right-Left and Compass methods we found several things to be true. Among the important we restate that Right-Left is the easier method for the people in this vicinity. North is the easier point of orientation. Habit or usage influences one's facility. People who live in rural sections seem to have more interest in compass directions than urban people.

We also found that people underestimated their ability to use Compass Orientation. If people would make a point of being compassly oriented at all times they would probably find it to be a simpler method than Right-Left.

Right-Left Orientation is used in driving, military commands and hunters use it quite often in conjunction with Compass Orientation. Jim Smiley in his trapping experiences

says, "A brook over to the right was flowing eastward, which was "right" to my way of thinking." Behavorial Orientation is used when one has the goal in mind such as finding one's way home from some point. It has been proved that ambidextrous people have a greater ability in the use of Compass Orientation. This latter type is most often called into play when observing maps and interpreting them. So when we glance through the many things we do, we find many instances which require some type of orientation and realize the value of this study of the process.

For years scientists have studied the process of orientation in animals but we have not stopped to realize that if we would analyze a similar process in ourselves we might be able to comprehend these studies more intelligently. We do need to put ourselves in a similar situation. We do need to analyze our thoughts before we can fully understand this problem.

Introspection, a scientific attempt to measure the abilities of these ninety people, the responses to one hundred people to a previously mentioned questionnaire, the experiences of hunters and hikers with whom I have talked, have all led to these conclusions concerning orientation.

May I emphasize again for the reader the three different types of situations in orientation. We may orient in relation to ourselves. This we have termed right and left in our language. We sometimes orient in relation to some set or absolute facts in nature. In our language we have called certain points North, East, West and South. There are

means we have of getting our relationships with the objects of our environment. We have another type. That is what I have called Behavioral Orientation. We set up a mental frame of reference and visualize ourselves in it as we get various cues by means of the five senses. The five senses, memory and observation are all essential. Find yourself disoriented and you will attempt to establish your relationship to your surroundings by one of these methods. You will recall that you have been taking left hand turns all the way. You will then retrace your steps making right hand turns noticing as you reach each corner whether or not you remember anything familiar down that street. This is not always an effective way and some people will become completely lost, especially if some turns were right and some were left.

Or, you may orient with absolute orientation, noticing the sun, establishing the relationship of your home with the sun in its present position and work your way back in that direction. Then again, you may have set up a frame of reference in which you visualize yourself in a given relation to your home. Regardless of right, left, north or south you know that if you go this way for a short distance and then take a ninety degree angle turn you will be in the vicinity of your goal. People vary greatly as to the use of any of these. Some are especially successful in one type and some relatively poor in all. Human beings have no special sense which will lead them to their own destination. They have to remember, organize their observations, and set up their own relationships.

CONCLUSIONS

1. Right-Left Orientation is more commonly used than Compass Orientation.
2. Right-Left was proven to be easier for people in this vicinity.

   68.5% Preferred Right-Left on Questionnaire.

   65% Did best on Right-Left Test.

   22.8% Preferred Compass on Questionnaire.

   32% Did Best on Compass Test.
3. Orientation from the North gave less difficulty in Compass Orientation.
4. People who are ambidextrous show a superior ability in Compass Orientation.
5. Living in a home in which directions are given in compass terms, or in a rural district may encourage the use of Compass Orientation.
6. Visual, kinaesthetic and auditory cues with observation and memory of these details are all important in being well oriented.

We hope that this forward step in the study of orientation in human beings will be an incentive to further investigation in the problem, for this will surely help us to better understand the problem of orientation in all animals.

REVIEW OF LITERATURE

One of the recent books upon the subject of Orientation is Raubaud's "How Animals Find Their Way About" published in 1928. This book relates experiments upon wasps, bees, ants, and other animals with the intention of showing the use of visual, olfactory and other cues. The work does not leave one with a final definite opinion as to the way in which animals do orient. Perhaps the experiments lack percision. Somehow his dismissal of migration as separate from homing and the opinion that migration defends on "hereditary topographical memory" we cannot accept readily. We do not wish to discredit the work of Rabaud. It is outstanding as a landmark in the more recent opinions regarding orientation. Whereas, most of the older experimenters thought the process could be explained as belonging to some special sense, Rabaud like most of the later scientist accredits the ability to perception from more than one sense. The book has also attracted popular attention which is valuable.

Earlier work such as that of Viguier, Reynaud and Benet are given in psychological and philosophical journals. Each proposed some theory and these we have mentioned in Chapter I. The value of these articles is an historical one. It is interesting to trace the theories of the scientists. These articles are for the most part, theoretical, backed by occasional observations, some of which show meager data.

In the Bibliography another interesting group of references will be found which are popular in nature and written for the lay mind. Some of these are based on the material proposed by

scientists and show the trends of thought regarding the problems of orientation and the "sense of direction."

Probably the most valuable article to give both a survey of the theories which have been proposed and an incentive to experimental investigation was that of J. B. Watson and K. S. Lashley written in 1915, entitled "An Historical and Experimental Study of Homing." This is the report of work done under the auspices of the Carnegie Institute at Bird Key, Tortugas, Florida upon Noddy and Sooty terns. The article discusses the various theories and previous attempts to give to animals a special sense. These they discredit with experiments. They succeed in breaking down these theories and conclude that visual and kinaesthetic senses aid proximate orientation but that they have no explanation for distant orientation. This indeed a stimulus for investigation.

A book written in 1932 by Jaccard, a French scientist, reviews the present problem of orientation. His book "Le Sens de La Direction Lointaine chez L'Homme" is not based upon experiments but is a theory as to how animals and men orient. M. Jaccard divides orientation according to the distance. He stresses the use of landmarks and the importance of memory. He discredits many of the stories concerning savages and concludes that there is no special sense of direction.

There follows a complete bibliography of the articles and books read previous to the writing of this thesis.

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