# Research Report

## COMPARISON OF AUTOKINETIC MOVEMENT PERCEIVED BY NORMAL PERSONS AND DEAF SUBJECTS WITH BILATERAL LABYRINTHINE DEFECTS*

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## SUMMARY PAGE


### THE PROBLEM

The object of this study was to determine the effect of an absence of the sensory organs of the inner ear upon autokinetic movement.

### FINDINGS

Autokinesis as perceived by nine normals and nine bilateral labyrinthine defective (L.D.) subjects was measured by a simple and highly reliable method. Each subject participated in two trials (one sitting, the other recumbent), each of about fifteen minutes' duration. The results confirmed an earlier finding that the sensory organs of the inner ear are not essential for the perception of autokinetic movement. Furthermore, the amount of angular autokinetic movement was found to be significantly greater, on the average, in the labyrinthine defective group than in the normal group of subjects. These findings suggest that the sensory input from the organs of the inner ear under the conditions of the experiment tended either directly or indirectly to stabilize the fixation target in space. No significant differences in autokinesis were manifested between the two head (body) positions for either group.


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## INTRODUCTION

The principal objective of the present investigation was to measure the effect of deafferentation of the sensory organs of the inner ear on the autokinetic phenomenon.* Insofar as we are aware, the only previous study dealing specifically with this problem consisted of a comparison of actual and autokinetic movements in seven deaf persons with complete or nearly complete destruction of the nonauditory labyrinths (4). With target actually moving in random fashion a distance of 5 to 7 feet in one minute, the subjects attempted to trace on paper the pattern of movement. The estimate of distance traveled varied from 1 to 10 feet, with a group average of approximately 5 feet. With target stationary the estimated average distance of the autokinetic movement ranged from 1 to 6 feet, with a group average of over 2 feet. The three subjects who reported the highest values for the actual movement also reported the highest values for the autokinetic movement. It was concluded that the sensory organs of the inner ear were not essential for perception of autokinesis but left unanswered the question as to what role if any they played. The findings in the study now to be reported suggest, if they do not prove, that the absence of the sensory organs of the inner ear increases the tendency to perceive autokinetic movement.

## PROCEDURE

### SUBJECTS

Nine normal persons aged 17 to 32 and nine deaf subjects aged 20 to 45 with bilateral labyrinthine defects (L. D. subjects) were tested. All of the subjects were males. All in the control group were students; seven were medical students. The L. D. group consisted of six students and three instructors from Gallaudet College. The clinical findings and results of functional tests of auricular sensory organs on this group are presented in Table 1.

### APPARATUS

The experiment was carried out in a dark room containing an inner cubicle in which the subject either sat or lay on his side (Figure 1). A chin and forehead rest were provided to stabilize the head of the subject when he was seated on the stool. When on his left side, the subject's head and shoulders were fixed by means of a molded fiberglass appliance, and his body rested on a four-inch foam rubber mattress. The autokinetic

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*Autokinesis may be defined as the apparent movement of objects when viewed against a background in which visual cues are inadequate. The basic mechanism is unknown.

Table I

Clinical Findings and Results of Functional Tests of Auricular Organs of the Labyrinthine Defective Subjects

| | | Past History of Deafness | | General | Hearing | | Residual Function: Semicircular Canals | | Residual Function: Otolith Organs | |
|---|---|---|---|---|---|---|---|---|---|---|
| Subj | Age | Etiology | Age of Onset | Health | R | L | R | L | Counterrolling | Oculogravic Illusion |
| ST | 20 | Meningitis | 2-1/2 yrs | good | ≥ 130 db | ≥ 135 db | none | none | 1.5° | normal |
| PE | 33 | Meningitis | 12 yrs | good | none | none | none | none | practically nil | greatly reduced |
| GU | 21 | Meningitis | 4-1/2 yrs | good | ≥ 145 db | ≥ 145 db | none | none | 1.0° | normal range |
| HR | 29 | Meningitis | 13 yrs | good | none | none | none | none | practically nil | moderately reduced |
| LA | 23 | Meningitis | 6 yrs | good | ≥ 115 db | ≥ 110 db | none | none | 1.5° | moderately reduced |
| ZA | 20 | Meningitis | 3-1/2 yrs | good | ≥ 135 db | ≥ 130 db | none | none | practically nil | moderately reduced |
| JO | 34 | Meningitis | 7-1/2 yrs | good | none | none | none | none | 2.0° | none |
| MY | 25 | Meningitis | 8 yrs | good | none | none | none | none | 1.0° | none |
| DO | 43 | Meningitis | 13 yrs | fairly good | none | none | none | none | 1.0° | probably none |

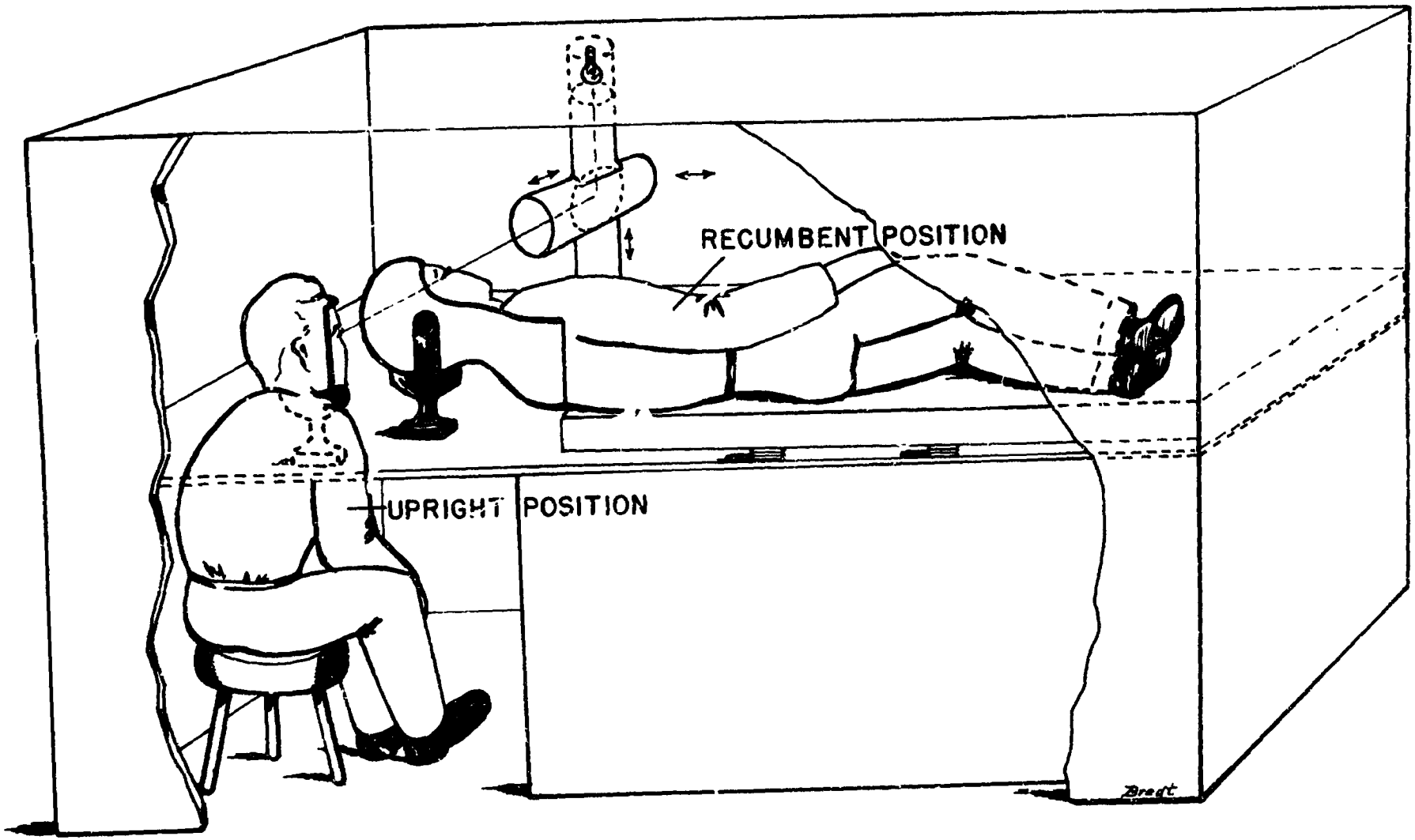


Figure .1

Diagram of the Apparatus Used to Determine Autokinesis in an Upright or Recumbent Position

stimulus was a dim point source of collimated light, 1.5 meters from the subject. Data were collected with the aid of a reference chart (Figure 2 a,b) and tape recorder.

## METHOD

Each subject was provided with a detailed written description of the procedure and received instruction in the use of the tape recorder and reference chart.* With cubicle lighted and the subject's head fixed, the center of the chart was placed directly before his dominant eye, the other having been covered with an opaque patch. He was required to commit to memory the approximate angular dimensions of the rings which were to be used in estimating distance from the center of the visual field, i.e., inner, middle, and outer third. The radial direction was estimated using the numerals on a clock dial. The chart was then removed and the room darkened. The target light was placed in a fronto parallel plane at a distance of 1.5 meters and adjusted vertically and horizontally in this plane so that it appeared directly before the subject's dominant eye. On signal, the subject fixated the target and gave a running account for about fifteen minutes of all perceived movements which was tape recorded. After a rest period of at least thirty minutes the experimental trial was repeated with the subject lying on his left side. At the end of each of the two periods the subject assisted the experimenter in plotting the autokinetic movement on the reference chart (Figure 2 c,b) based on a playback of the tape recording.

The apparent movement of the target from one identified position to another was represented by a straight line when the actual path of travel was not described. This is an approximation since autokinetic movement is not restricted to a rectilinear course and may have followed other forms such as a curve, or wave. In addition, movement of the light toward and away from the observer occasionally was reported spontaneously, but no attempt was made to estimate the extent of this movement. Even with this procedure, individual variations or errors in judging spatial relationships without the aid of visual reference cues could exist and affect the reliability of this method especially for absolute measurements of autokinesis. This method, however, has the advantage of being relatively simple to use and yielding a fairly high test-retest reliability. A measure of reliability was obtained by correlating the average apparent movement found in the upright position with that in the recumbent position ( $r = 0.97$, normals; $r = 0.80$, L. D. subjects).

Each subject participated in two trials, one sitting, the other recumbent. The total linear distances plotted on these charts were measured and converted into angular magnitudes. These values divided by the total time yielded the number of degrees of apparent movement per minute for each subject in the two head (body) positions.

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*Subjects (PE, DO, JO) were given verbal instructions in lieu of a display of the reference chart.

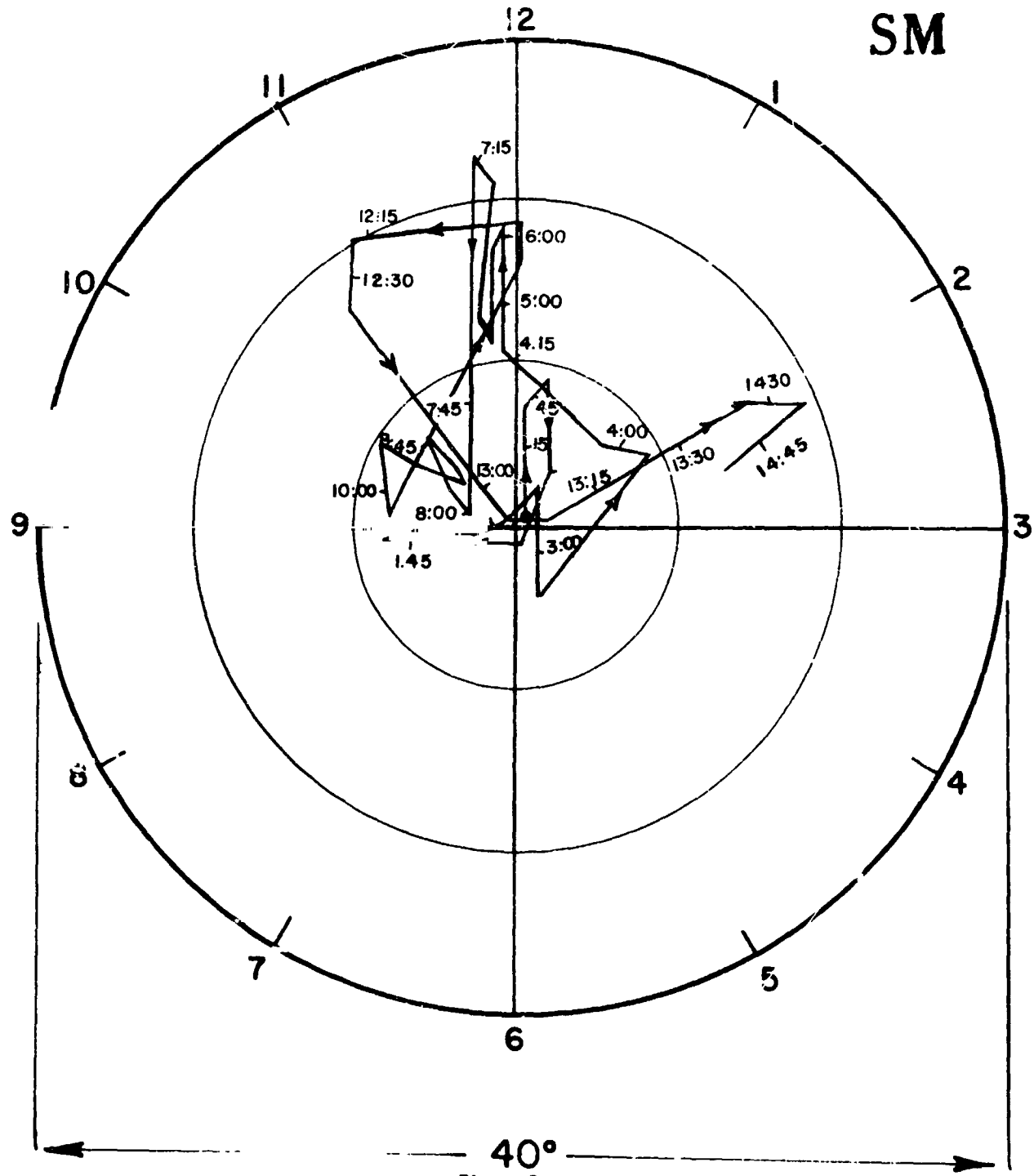


Figure 2 a

An Estimated Record of the Autokinetic Movement in a Normal Subject (SM)

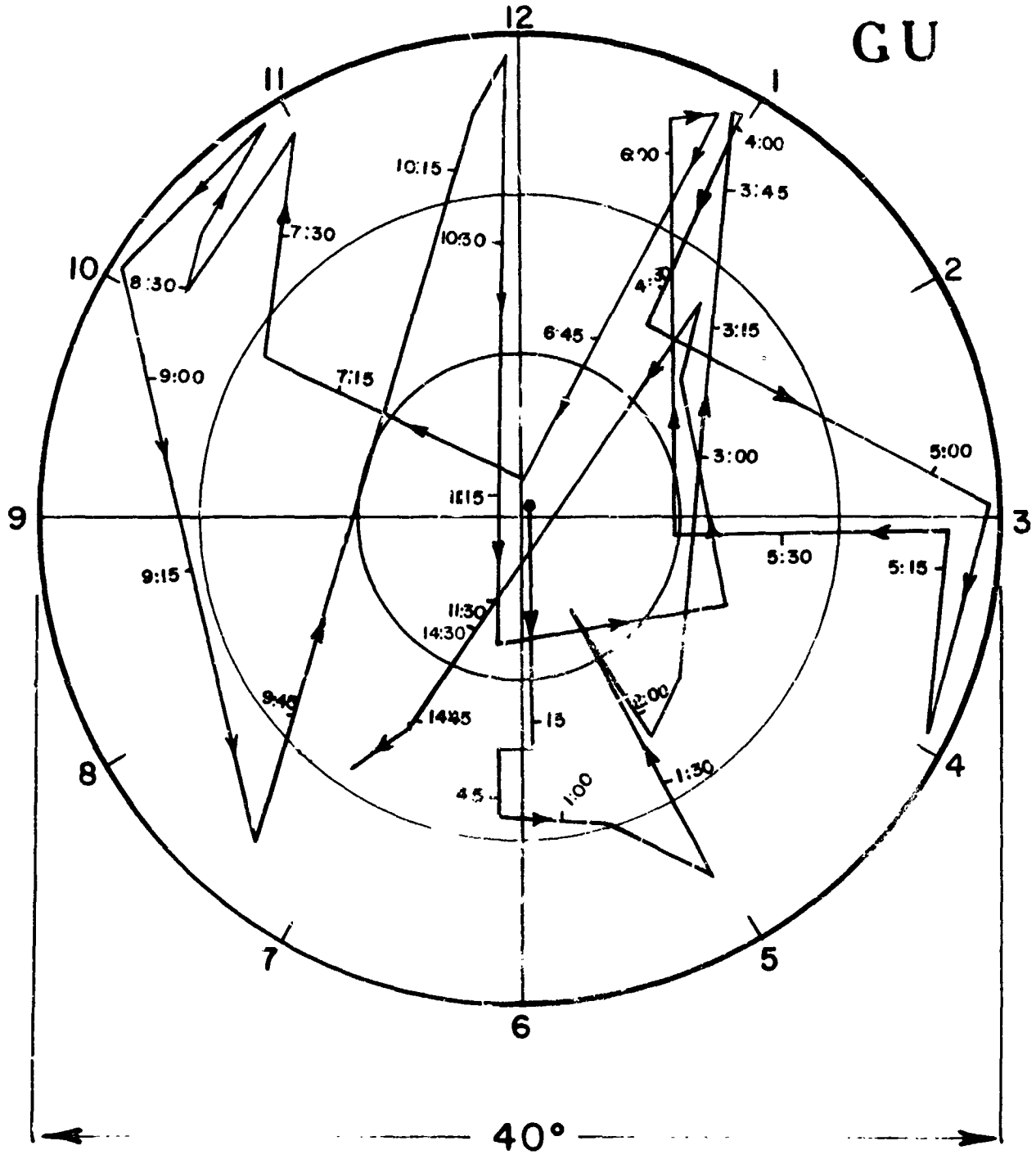


Figure 2 b

An Estimated Record of the Autokinetic Movement in an L. D. Subject (GU)

## RESULTS

Shown in Figure 2 a,b are a chart of a normal subject (SM) and one of an L. D. subject (GU) manifesting nearest to average amounts of autokinesis in their respective groups. The results of all subjects are summarized in Table II. It is apparent that a considerable difference in the average autokinetic movement exists between the two groups. This intergroup difference for both head (body) positions was found to be significant, standard error of the difference, $\sigma_d = 5.3$, upright; $\sigma_d = 4.7$, left side. On the other hand, intragroup (normal and L. D.) differences were not significant in either position.

Although significantly greater average autokinetic movement was perceived by the L. D. subjects, there is some overlap of the individual scores among the two groups.

## DISCUSSION

Many factors, in addition to variables related to the fixation target and visual background, have been shown to influence autokinetic movement including pathological states (4,7,10), fatigue (1,3), the exhibition of drugs (1), suggestion (1-3, 8) auto-suggestion (2,5), stimulation of proprioceptors in eye and neck muscles (1,2,6), and stimulation of the sensory organs of the inner ear (6,9). It is evident that all of these factors somehow must influence illusory movement, but the mechanisms involved are largely unknown and even difficult to classify.

With regard to stimulation of the sensory organs of the inner ear, it has been reported that heat applied over the mastoid region caused the target to appear to move preferentially toward that side (6); that galvanic stimulation, using external electrodes, produced on apparent target movement toward the ear with negative electrode (6); and that an acoustic stimulus resulted in directional autokinetic movements (9). In interpreting these findings it is necessary to point out that the semicircular canals might have been stimulated with each of the three stimuli mentioned above and that this, in turn, might have resulted in a form of apparent movement, the oculogyral illusion, which is indistinguishable at times from autokinesis (4). Thus a question remains whether the above findings indicate an influence on autokinetic movement or the substitution of the oculogyral for the autokinetic illusion.

Table II

Summary of the Average Apparent Movement in Degrees of Arc Per Minute For the Normal and L. D. Subjects

| | Head (Body) Position | |
|---|---|---|
| | Upright (Trial 1) | Left Side (Trial 2) |
| **Normal Subjects** | | |
| HI | 1.1 | 3.2 |
| HY | 5.1 | 9.7 |
| ZE | 10.5 | 12.4 |
| GI | 4.3 | 8.4 |
| SM | 9.5 | 13.8 |
| HU | 4.1 | 5.9 |
| TH | 0.7 | 7.0 |
| CY | 24.0 | 28.6 |
| NU | 32.1 | 31.9 |
| Average: | 11.2 | 13.4 |
| S. D. | 9.7 | 9.5 |
| **L. D. Subjects** | | |
| LA | 46.6 | 41.0 |
| GU | 22.7 | 21.6 |
| JC | 13.5 | 15.1 |
| PE | 13.2 | 17.3 |
| MY | 21.6 | 20.0 |
| HR | 40.0 | 37.3 |
| ZA | 31.3 | 40.0 |
| ST | 43.7 | 42.1 |
| DO | 13.4 | 34.2 |
| Average: | 27.3 | 29.8 |
| S. D. | 12.7 | 10.5 |

With regard to deafferentiation of the sensory organs of the inner ear, the results in the present experiment not only confirm the earlier findings (4) that the sensory organs of the inner ear are not essential for the perception of the autokinetic phenomenon, but they also indicate that the amount of angular movement is greater in persons who have little or no residual function of these sensory organs compared with persons in whom these functions are normal. If these findings are valid, it follows that the sensory input from the organs of the inner ear under the conditions of our experiment either directly or indirectly tended to stabilize the fixation target in space.

Unfortunately our data do not offer an opportunity to distinguish between the relative roles of the three organs concerned except possibly in the case of the otolith apparatus. Some of our L. D. subjects had a significant degree of residual function of these organs as measured by the oculogravic illusion test. A comparison between the amount of autokinesis in the four subjects with little or no function and the five with a significant residuum shows no regular differences, but the numbers are small.

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