A STUDY OF THE EFFECTS OF FOUR BODY POSITIONS ON THE VISUAL PERCEPTION OF VERTICALITY IN THE APPARENT FRONTAL PLANE

Thesis for the Degree of M. A.
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Richard F. Haines

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ABSTRACT

A STUDY OF THE EFFECTS OF FOUR BODY POSITIONS ON THE VISUAL PERCEPTION OF VERTICALITY IN THE APPARENT FRONTAL PLANE

by Richard F. Haines

Previous studies have dealt with the lateral or side-to-side tilt of the body while administering a perceptual test of verticality. This body tilt seemed to effect the position of an illuminated rod when adjusted to the subjective vertical. The present study tilted Ss forward and backward while administering the perceptual test. The test consisted of placing the rod so that both ends of it were equal distance from S. The four body tilts that were used were: (1) that tilt giving vision 10° below the horizontal, (2) that tilt giving horizontal line of sight, (3) that tilt giving vision 10° above the horizontal and, (4) that tilt giving vision 45° above the horizontal.

Another variable was studied in this experiment. This was the effect of the initial position of the stimulus rod on its final position. This variable was systematically studied by administering different initial rod positions to S while he reclined in a contour chair that could be tilted into the above four degrees of tilt.

Twenty two of the twenty four Ss were volunteers from beginning psychology classes at M. S. U. during the summer term. Twelve were male and twelve female. Each S adjusted the rod to the subjective vertical himself. The true vertical was a plumb line,

when S was in the 0° tilt position, and at other tilts was defined as that position where both ends of the rod were equal distance from S.

An analysis of variance was performed on the data obtained from this experiment. The three main effects were chair position, rod position, and sex of S. None of these was found to be statistically significant at the .05 level. Three two factor interactions were also calculated and one was significant at the .05 level. This was the interaction of chair position with sex. The three factor interaction of chair-rod-sex was not found significant. These results were portrayed in graph form and in a schematic diagram (Figure II) as well as being discussed.

Although the analysis was not statistically significant the data did suggest that male Ss showed a larger deviation from a perfect rod setting than did female Ss in all tilts except the +45° tilt. In this tilt female Ss tended to show marked deviations from perfect settings. This finding was explained as being at least partially due to the experimental conditions. Studies were discussed that related to this study and a summary included.

Approved S. Herman Bailey
Major Professor

Date March 5, 1962

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By

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R. F. H.

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INTRODUCTION

The subjective vertical can be defined as an individual's perception of the true vertical. The subjective vertical has been studied by many investigators and it has been found that with a small sidewise tilt of the body a luminescent line in the dark will be perceived as vertical when it is tilted an appropriate number of degrees in the opposite direction of the body tilt. This phenomenon has been called the E-phenomenon (after G. E. Müller). In most of these studies S was tilted in the lateral plane, i.e., from side to side, and the effect of this body tilt has been noted upon his visual perception of the vertical. Müller (6) refined an earlier study by Aubert (3) and found that when the head was tilted very little the apparent tilt of the stimulus rod was in the same direction as the head tilt; but when the head tilt was greater the stimulus rod was placed in direction opposite to the tilt of the head.

Other studies have examined the subjective vertical under many different kinds of conditions. In some of these studies (7, 12, 17) the force of gravity upon S was altered by using a centrifuge while in other studies (2, 4, 5, 9, 10, 13, 15, 19) the subject was tilted. Several other experiments (1, 8, 16, 20) have studied the effects of tilting the whole environment in which S sat during the perceptual test. An experiment by Werner and Wapner (14) dealt with the effect of the starting position of the stimulus rod

on the subjective vertical. This variable was studied in order to determine if factors other than body tilt would effect the subjective vertical. In all of these studies S was required to adjust an illuminated rod from some starting position to the position that he felt was vertical. This final position was called the subjective vertical.

The basis upon which most of these studies were performed seemed to be an implicit assumption concerning the various elements making up perception of the subjective vertical. Woodworth and Schlosberg (20, pg. 525) make this assumption more explicit when they write, "...your visual perception of the vertical is a compromise between that dictated by gravity and that shown by the visual field." This passage illustrates the physiologically oriented perceptionist's assumptions; for under the two headings of gravity and vision the other factors can be arranged. Some of these researchers assumed that the behavior of adjusting a rod to the subjective vertical involved the integration of many physiological processes.

The series of experiments performed by Werner, Wapner, and Chandler on the sensory-tonic field theory of perception all dealt with visual perception of the subjective vertical. These experimenters performed an experiment (13) that attempted to reveal some factors involved in perceiving the subjective vertical other than the visual factor. It dealt with the effect of supported and unsupported body tilt on the visual perception of the vertical. The results of their experiment indicated that under identical angles

of body tilt, the subjective vertical was displaced to a greater degree when the body was unsupported than when it was supported.

Under conditions of being fully supported, S sat in a chair that was provided with a headrest, sides and back; thus the body was held firmly in place. Under relatively unsupported conditions S sat on a stool, and was required to maintain his body in the desired incline by his own muscular efforts.

Since the experimental task required S to maintain a given degree of tilt by using his own muscles in the unsupported condition the experimenters concluded that the greater degree of displacement of the rod from vertical was due to greater muscular involvement. They felt that the degree of muscular involvement of S was more important than the degree of body tilt per se. in causing the subjective vertical to be displaced from a perfect setting. In this study Ss were tilted in the lateral plane, i.e., from side to side.

So far as the writer has been able to determine, only one study directly concerned with body tilt in the forward-backward direction is represented in the literature. This was a study done by Schubert and Brecher (10). These two researchers attempted to determine the effect on one's visual perception of the vertical if he were tilted in the medial plane (forward and backward) rather than in the lateral plane as had always been done before. They administered the perceptual test at certain fixed degrees of body tilt. S's task was to adjust the stimulus rod to the subjective vertical so that both ends of the rod were equal distance from S. This position was defined as the subjective vertical by Schubert and

Brecher.

In contrast to the body support used by Werner, Wapner, and Chandler; Schubert and Brecher used a huge frame within which S stood. The frame had body fitting supports at the shoulder, waist, and ankle levels. The entire apparatus was mounted on an axle which permitted it to be rotated through a full 360°. The S within this frame could then be placed in any degree of tilt with respect to gravity while adjusting the stimulus rod to the subjective vertical. The only places that S's body weight was supported were at the three body braces which fit the contour of his body. One exception to this was the upright tilt when S could stand in the frame. When S was not in the standing position he was in a relatively unsupported condition.

The results of this experiment showed that in the case of a forward body tilt the stimulus rod, in order to appear vertical, had to be tilted by a certain amount toward the body. In the case of a backward body tilt, it had to be tilted away. These findings are similar in direction of rod setting to those found in experiments applying lateral tilt of the body (3, 6, 12, 13) even though this experiment used medial tilt of the body. Figure I schematically illustrates the results obtained by Schubert and Brecher for tilts of 90° backward (vision that was straight up), 45° backward, 0° (vision that was horizontal), 45° forward, and 90° forward (vision that was straight down). Note that in general as the amount of body tilt increased from standing position the angular deviation of the subjective vertical also increased from the true vertical. 0° body tilt produced the smallest angular deviation of the rod from a per-

feet rod setting. Schubert and Brecher's original study consisted of 8 different body tilts through the entire 360° of rotation the first being the upright position and the rest at each 45° interval. Only the above five positions were included in Figure I for clarity and relevance to the present study.

Interpretation of these results must take into account the kind of body support used by Schubert and Brecher. From the previously mentioned study (13) concerning supported and unsupported body tilt one would expect that Schubert and Brecher's apparatus would have a large effect on the results. S merely stood in the huge frame in the 0° tilt and made his rod adjustments. In the 45° forward and backward tilts, on the other hand, S had to adjust the rod while his body was pressing down on three semi-contoured forms that extended across his shoulders, across his waist, and across his ankles. This bodily strain also occurred in all of the other tilts that were administered. As long as S was not let out of the apparatus the strain would continue.

It was felt that Schubert and Brecher's experiment was an important one having relevance to situations encountered in everyday life and that it should be at least partially replicated with better control of the body support. In order to do this a chair was built and two studies using it were carried out. The first of these was a preliminary study to determine if the chair would provide adequate body support throughout the test period. This study was also an attempt to determine if there would be an effect on S's perception of the vertical when he was tilted in four different degrees of

tilt. The second study that was performed is that study reported in the present thesis. The second study differed from the first in that in the second study the stimulus rod rotated in the medial plane (forward and backward) while in the first study it rotated in the frontal plane (from side to side). Appendix A presents a schematic diagram of the plane of rotation for the stimulus rod as well as other planes for descriptive purposes.

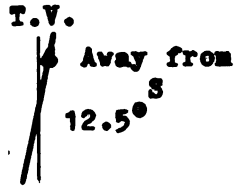
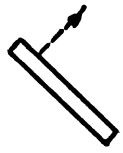
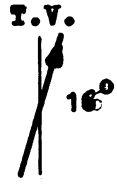
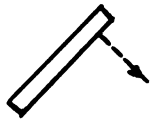
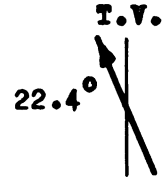
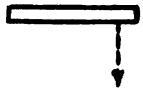
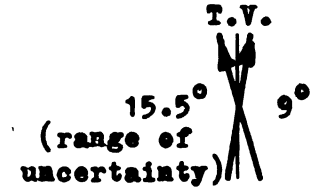
The results of the preliminary study carried out by the writer showed that if S's eyes were kept closed he could not tell what degree of tilt he was in, especially when he was tilted very slowly into the position. The results also showed that the chair did not cause Ss to feel tired throughout the entire test. The degree of body tilt did effect the position of the subjective vertical but in an inconsistent manner. This result would seem to warrant further study.

The second study, presented in the present thesis, dealt with body tilt in the forward-backward plane as did Schubert and Brecher's. The difference between the two studies is twofold; first, the present study tilted Ss in only four different degrees of tilt while Schubert and Brecher tilted their Ss through the entire 360° in 45° intervals; and second, the present study provided full support for the body in each of the four tilts while Schubert and Brecher did not.

It is a valid question to ask if body tilt in one plane has anything in common with body tilt in another plane. Likewise when a variable is found that effects visual perception of the vertical in one plane it is a valid question to ask if that variable might

Figure I

Results Obtained by Schubert and Brecher for five different body positions

Tilt Position	Diagram of S's Position	Mean Setting of the rod from true vertical
90° Backward		
45° Backward		
0°		
45° Forward		
90° Forward		

Key

Symbol	Explanation
▭	Longitudinal body axis
---►	Direction of S's vision
T.V.	True Vertical (Rod's ends equal distance from S)

also effect visual perception of the vertical in another plane. Just such a variable was found. A previous study (14) found evidence that the initial position of the stimulus rod effected the resultant position. The subjective vertical, in general, was found to depend upon the position at which the rod was placed at the beginning of a trial. The question was raised whether or not this phenomenon would occur when the stimulus rod rotated in the forward-backward plane rather than in the frontal plane as it did in the above mentioned study. All three of the initial rod positions used in the study gave confirmation of the statement that, "the apparent vertical is always closest to the position in which the rod was set initially for that trial." (pg. 70) These three initial positions were all in the apparent frontal plane of S. No matter what degree or direction of tilt S was placed in the stimulus rod always rotated in a plane that was 90° to his line of sight. Three initial rod positions were used in the present thesis study although the rod now rotated in the medial plane (forward and backward) so that the rod's top swung toward S and its bottom swung away or vice versa.

METHOD

Experimental Design:

The four degrees of body tilt used in this experiment were labelled according to the number of degrees above or below horizontal vision extended when S fixated on the center of the stimulus rod. If vision was below horizontal it was arbitrarily called minus (-). If it was above horizontal it was called plus (+). The four degrees of body tilt were; -10°, 0°, $+10^{\circ}$, and $+45^{\circ}$.

Three initial positions of the stimulus rod were presented to S in each of the four body tilts. These initial positions were; 20° from the position defined as true vertical toward S (so that the rod's top came toward S), 0°, and 20° from the position defined as true vertical away from S (so that the rod's top receded from S).

The stimulus rod was considered to be in the true vertical position when it was positioned at 90° to S's line of sight. When S was tilted into some degree of tilt and he fixated on the middle of the rod the true vertical position was taken as that position where both ends of the rod were equidistant from him. This was identical to the procedure used by Schubert and Brecher (10). This procedure was also used in order to keep the visual conditions as close as possible to those encountered in horizontal vision. Thus if S were looking horizontally the rod would be truly vertical with

respect to gravity when it was 90° to his line of sight. The experiment was not meant to determine if S could estimate the tilt he was placed in but to study the effect of body tilt upon the visual perception of the rod's position had S been looking horizontally. By having S always try to place the rod in the same position* under different body tilts an assessment could be made as to the amount of angular deviation being produced by the tilt.

Since five minutes were given each S to adapt to a new degree of tilt it was prohibitive to randomly present all experimental conditions of rod position and chair tilt. It was for this reason that the three initial rod positions within each degree of tilt were randomized and the order of presentation of the four tilts was randomized separately. Each of the three initial rod positions was assigned a number from one through three and each tilt a number from one through four. The table of random numbers (11, pg. 484) was entered at a point chosen by putting consecutive numbers from 00 to 60 on slips of paper and picking one (without sight) for the line to be entered. This was repeated using numbers from 00 to 14 for the column to be entered. The order of presentation for the three rod positions was determined by selecting the numbers one, two, or three in the order they appeared in the table and recording them directly onto the score sheets. The order of presentation of body tilt was determined similarly.

Stimulus Object:

The stimulus object employed in all of the test conditions was

an illuminated rod 20 inches long and $^{15}/_{16}$ of an inch in diameter. The width of the rod subtended a visual angle of 39.65 minutes of arc. When the rod was placed in the apparent frontal plane and viewed for length it subtended a visual angle of 11.95°. The stimulus rod piveted about its center on a shaft. The rod was painted white and was illuminated by a 7½ watt red light situated 4 feet away and just below S's line of sight towards the rod. The rod looked white with a slight pink tinge.

Apparatus:

The apparatus consisted of a stimulus rod assembly and a chair with controls. The stimulus rod assembly will be described first. The stimulus rod assembly consisted of the illuminated rod, a dull black circular background, a protractor on the axis of rotation of the rod, and pulleys necessary for the rotary control of the rod by S. This entire assembly was supported by a rigid framework which was attached to the chair so that as the chair was tilted into various tilts the whole framework and stimulus assembly tilted with it. This was suppose to keep the eyeball movements small if S fixated on the center of the stimulus rod.

In all cases S controlled the movement of the rod by means of a series of pulleys and cord. The control knob was within easy reach of S's right hand.

Measurement of the amount of angular deviation of the rod was achieved by using a protractor. It was situated on the axis of rotation. A pointer was attached to the axis which was in turn

attached to the stimulus rod thus giving a direct measurement of the amount of angular deviation from the position of the rod that was 90° to S's line of sight. The protractor, which was periodically calibrated with a plumb line, was read to an accuracy of ½ of one degree.

Description of the chair is easiest by referring to the photograph found on the following page. The chair was constructed of two sides forming the contour and braced for torsion. The chair, stimulus rod, stimulus rod assembly, and controls were supported on a stand which allowed the entire apparatus to tilt forward and backward. Braces held the chair rigidly in each of the four degrees of tilt as required. An aircraft type seat belt was installed in such a position to help hold S in the chair when it was tilted in the more extreme tilts (-10° and +45°).

A completely adjustable headrest was attached to the chair. This headrest was padded for comfort and also to help reduce noises during the experiment. The head rest provided a means of holding S's head within a small range of lateral movement. It was readjusted at the beginning of each new chair tilt to help relieve any neck tension due to shift of body center of gravity when the chair was tilted into a new position.

A heavy weight canvas was laced to the sides of the contour chair. In the section of the seat where most of the body weight was situated an elastic cord was used to lace the canvas to the sides, in other areas cotton cord was used. This elastic shock cord provided a "softer" section of the canvas to help hold S into the

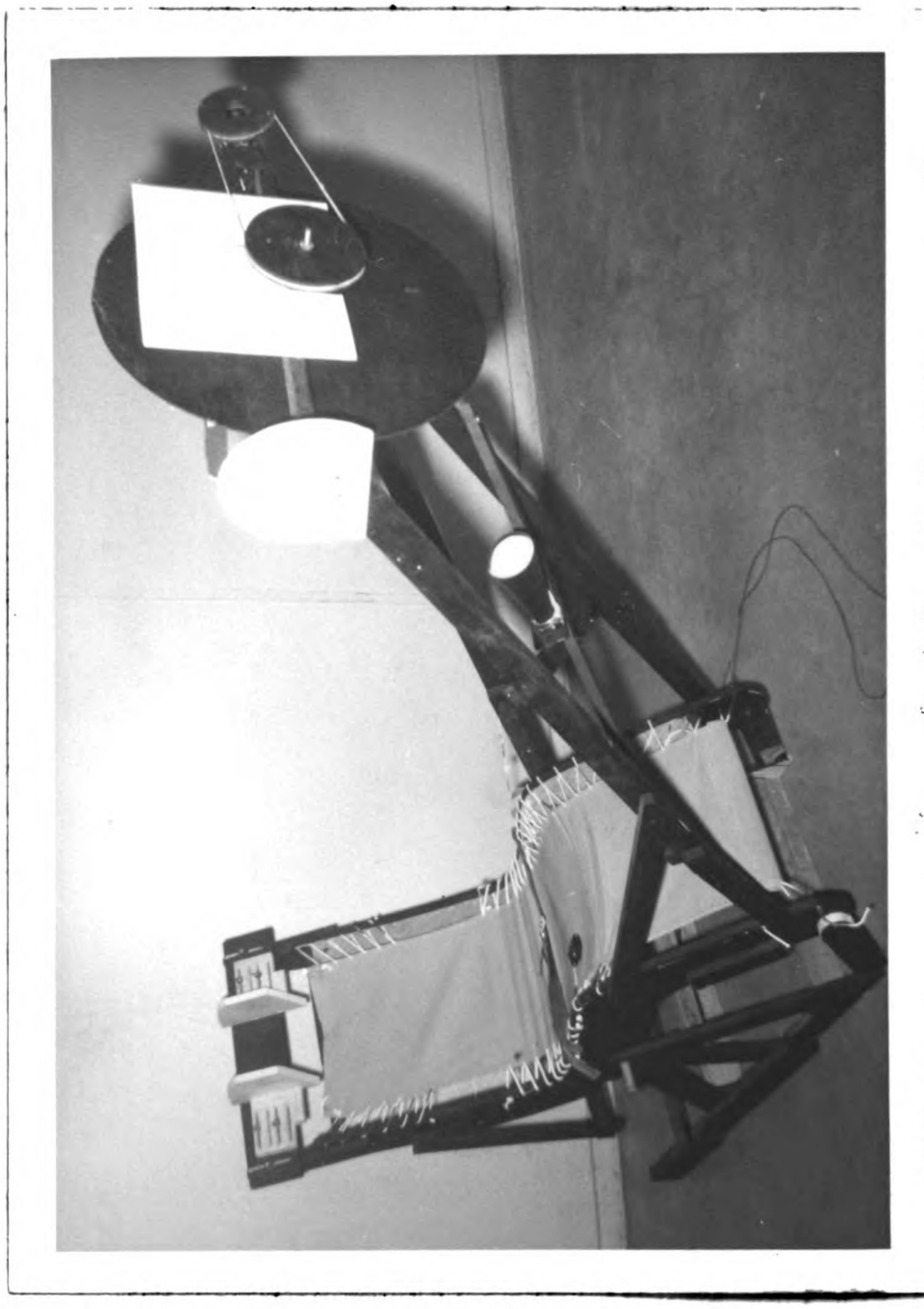


Figure II

Photograph of Apparatus

chair in the more extreme tilts.

In order to eliminate all room illumination means were taken to block the little light coming in around the window shades. Over the entire length of the chair and stimulus rod framework was stretched a black cloth. It hung down on both sides to form a tunnel. At its end was the stimulus assembly. A reduction screen of black cloth was also used. This screen was in the frontal plane at a distance of 4 feet from S's eyes. The circular hole permitted only a view of the black circular background and stimulus rod (when illuminated). Ss of differing heights had to be adjusted in the seat so that the black background was centered in the hole of the reduction screen. This arrangement of cloth eliminated essentially all of the light coming into the experimental area.

Subjects:

Twenty four Ss, 12 male and 12 female, were tested in this experiment. Their ages ranged from 18 to 26 years with an average of 21.4 years. Most of these Ss were naive. All Ss were volunteers from a beginning psychology class who received credit for their time.

Procedure:

The S was met at the door of the experimental room by the experimenter and taken to a chair with desk. Each S was provided with his own score sheet upon which the experimenter recorded the following information as well as S's rod settings: (1) name, (2) age, (3) sex, (4) university major, (5) date, (6) time, (7) handed-

ness and (8) an approximate Snellen rating of S's visual acuity. S was then seated in the apparatus, the seat belt passed over his lap and secured snugly to the other side of the chair's frame. S's head was then centered in the headrest. When S said he was comfortable in the chair the room lights were extinguished and a flashlight was used by the experimenter to point out S's control knob and light switch.

During the ensuing dark adaptation period the following instructions were given verbally to S.

> "You are about to take part in an experiment concerning visual perception. As you saw, there is a white rod in front of you. In your left hand is a light switch and in your right hand a knob to adjust the white rod. This knob will rotate the rod to any position. I want you to wait until you hear me say all right. Then you should turn on your light switch and open your eyes. You should then immediately begin adjusting the white rod to the position that makes both ends of the rod seem the same distance from you. Take your time. You will have from 10 to 15 seconds to make every adjustment. The important thing to remember is that I want a careful setting of the rod. Again, there is no hurry. Please keep your eyes shut except when you turn your light on. When you feel you are done adjusting the rod all you have to do is simply turn off your light and shut your eyes. When you do this it tells me that I can record your rod setting and reset the rod to a new starting position. Do you have any questions?"

Measures Employed:

The angular displacement of the stimulus rod that S made was

measured in degrees from the rod position that was 90° to S's line of sight. In recording the rod settings a plus (+) was used to indicate that the top of the rod was away from S and a minus (-) to indicate that the rod's top was toward S. Within each degree of chair tilt each initial rod position was administered twice to each S. The arithmetic mean of these two settings was used as the measure of S's performance.

RESULTS

Table I presents the results of the statistical analysis performed on the data from this experiment. The variables of sex, chair position, and rod position were analyzed. The interactions of these main effects were also analyzed. None of the three main effects was found to be statistically significant at the .05 level. Three two factor interactions were calculated and one was found to be statistically significant at the .05 level. This was the interaction of chair position with sex. The three factor interaction of chair-rod-sex was not found to be statistically significant.

Mean scores for designated chair tilts and all initial rod positions are presented in Graphs I and II. The ordinate represents the amount of angular deviation of S's setting from a perfect setting. The abscissa represents the degree of chair tilt. Male settings are graphed separately from female settings.

Generally male Ss set the top of the stimulus rod closer to themselves than did women Ss. One exception to this occurred in the $+45^{\circ}$ body tilt where female Ss tended to set the top of the stimulus rod two degrees closer to themselves from a perfect setting than did male Ss. Thus female Ss did a better job of locating the required position than did male Ss when they were not being tilted extremely.

Table I

F-Tests for the significance of difference of scores among experimental test conditions

Source of Variance	SS	df	MS	F	F*
Sex	30.40	1	30.40	.07	
Subjects within Sexes	8732.24	22	396.92		
Chair Position	343.38	3	114.46	.98	
Chair × Sex	1018.20	3	339.40	2.92*	
Chair × Subjects within Sexes	7688.53	66	116.49		
Rod Position	477.30	2	238.65	1.49	
Rod × Sex	350.47	2	175.23	1.09	
Rod × Subjects within Sexes	7077.88	44	160.88		
Chair × Rod	107.96	6	17.99	.25	
Chair × Rod × Sex	260.53	6	43.42	.61	
Chair × Rod × Subjects within Sexes	9631.71	132	72.96		
Total	35,718.60	287			

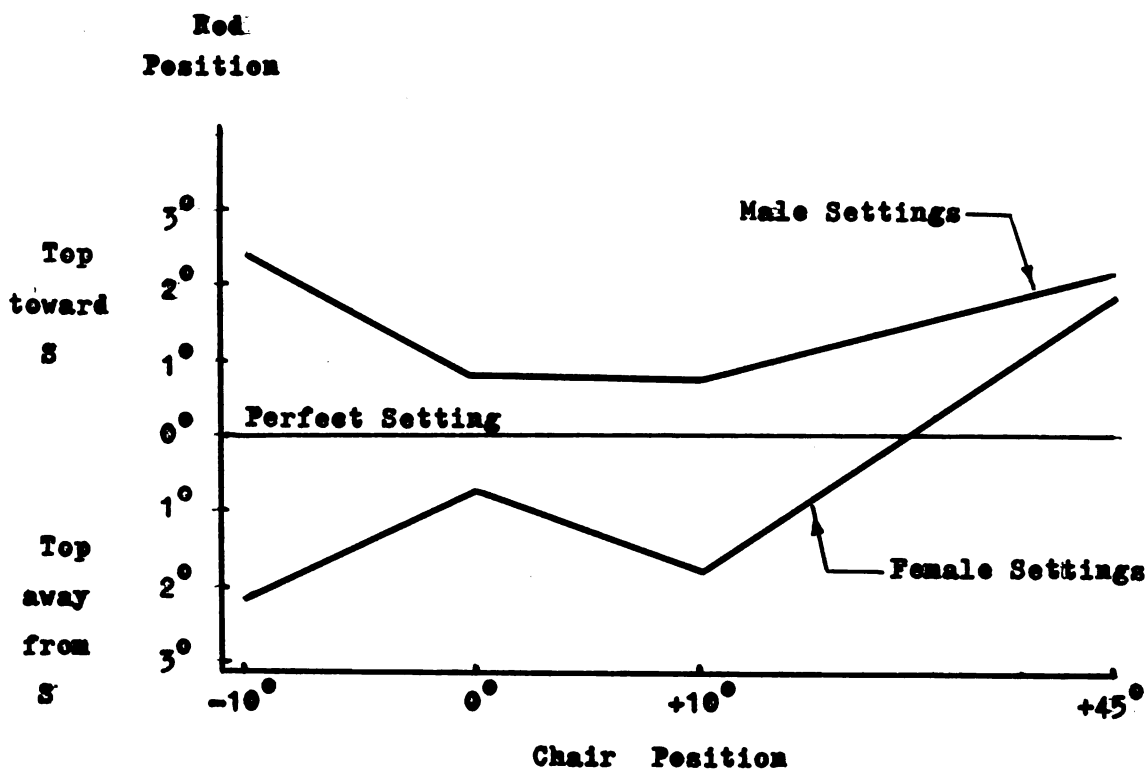
* Significant at .05 level

When tilted forward 10° both men and women tended to set the top of the stimulus rod toward them and when tilted back 45° they tended to set the top away from them. This finding is similar to that found by Schubert and Brecher (10). Comparison of Graph I with Graph II shows that the 0° initial rod position lead to rod settings (top of rod) closer to S than did initial rod positions of +20° or -20°.

It is obvious that both male and female Ss did not make perfect rod settings when a perfect setting was defined as that

Graph I

Mean scores obtained for male and female S's and initial rod position of 0°



Graph II

Mean scores obtained for male and female S's and initial rod position of +20° and -20°

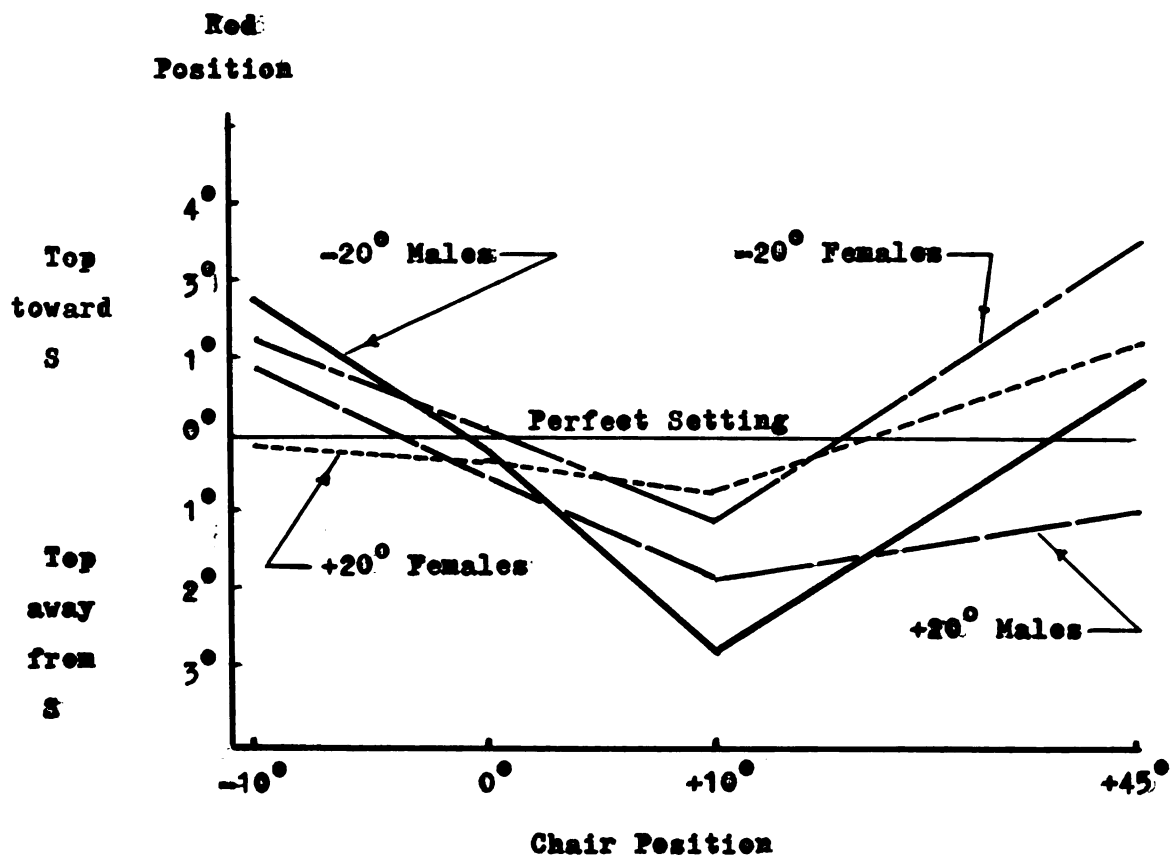
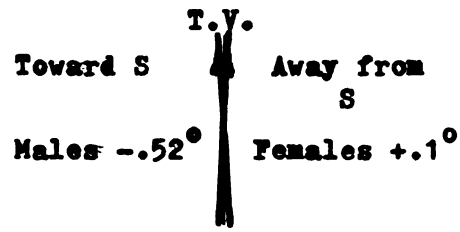
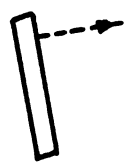
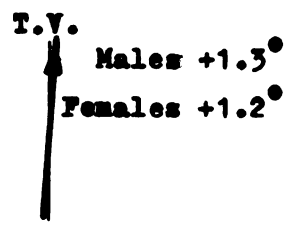
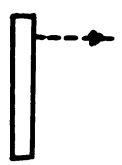
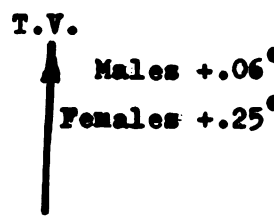
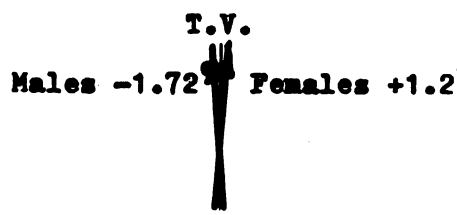
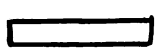
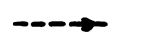


Figure III

Results obtained in the present experiment for four different body positions

Tilt Position	Diagram of S's Position	Mean Setting of the rod from true vertical
45° Backward		
10° Backward		
0°		
10° Forward		

Key

Symbol		Explanation
	. . . . .	Longitudinal body axis
	. . . . .	Direction of S's vision
T.V.	. . . . .	True Vertical (Rod's ends equal distance from S)

rod position where both ends of the rod were equal distance from S. Both graphs show the amount of deviation of S's settings in degrees from a perfect setting. Male Ss tended to make less erratic or wandering settings from a perfect setting than did female Ss. This was most clearly illustrated in Graph II. Intra-sex settings were more consistent than inter-sex settings.

Figure II on the preceding page presents the mean rod settings obtained in the present experiment in a form similar to that of Schubert and Brecher's results (presented in Figure I). The directional trends of S's rod settings are the same although the size of the angular deviations is smaller in Figure II.

DISCUSSION

The present study dealt with perception of the vertical and some of the possible factors related to its distortion. For the present study distortion of the vertical was taken to mean any rod setting that was not in the position where both ends of the rod were equal distance from S. At each of four discrete body tilts in the forward-backward plane S had to adjust the stimulus rod so that both its ends were equal distance from him. This study attempted to determine if any distortion would accrue from the body tilt.

The results of the present study did not lend support to the thesis that different degrees of body tilt will effect the position at which an illuminated rod is seen as having both its ends the same distance from S. The analysis did find a significant two-factor interaction however. The main effect of rod position was also not significant.

Although the main effect of chair position was not found to effect average rod setting to a statistically significant extent, it did produce a significant interaction with sex of subject. It appears that male Ss showed a larger deviation from a perfect setting than did female Ss, except when tilted back into the +45 tilt, where females' rod settings show a marked deviation from a perfect setting. In the +45° tilt female Ss might have become more

distracted from the task since this degree of tilt is unusual for a woman wearing a skirt.

Although neither the effect of the rod's initial position or the rod by sex interaction were statistically significant, the data suggest that if the initial rod position is 0°, which is already a perfect setting, male Ss set the top of the rod closer to themselves than if the rod were begun either closer or farther away from the 0° position. Female Ss tended to do just the opposite of what the male Ss did, i.e., they consistently set the 0° initial positioned rod farther from themselves than if the initial position had not been 0°. This would seem to suggest that males react differently to the starting position of the rod than do female Ss. The male settings are more regular than are female settings and the degree of body tilt does not effect males, and thus their rod settings, as much as it does female Ss. Werner and Wapner's study (14) also obtained similar sex differences.

Graph II illustrates the finding that rod settings are consistent within each sex and less consistent between sexes. This again suggests certain differences between male and female Ss. It seems to be a consistent finding of this experiment that Ss must move the stimulus rod in any direction before they will accept one position as being the required position. Witkin (15, 17) found marked sex differences. One of these studies uncovered a "field dependence" in women when they were laterally tilted within a tilted environment. Male Ss relied more upon the "physical aspects" of the situation when in the same degrees of tilt.

The writer takes the position put forth by Wapner, et al. (13, pg. 349) when they write, "the crucial postural factor (in causing distortion of the vertical) is not position per se but degree of muscular involvement. It is this factor which...contributes to changes in perception." The body support used in the present experiment should have kept muscular involvement to a minimum when compared to the body support used by Schubert and Brecher. As far as the writer can determine the other experimental conditions of the two studies are the same. Thus if muscular involvement is a factor in effecting one's visual perception of the vertical the smaller angular deviations from a perfect rod setting found in this study could be accounted for by the smaller amount of muscular involvement. Better techniques are needed with which to study this phenomenon before any definite statements can be made. The previously mentioned study by Wapner, et al. (13) showed that the degree of deviation from a perfect rod setting is greater for the unsupported than the supported condition. This study also showed that the displacement increases (from a perfect setting) if the body tilt is increased from an upright position. These findings would seem to support the above contention that the smaller angular deviations found in the present study, as compared to the findings of Schubert and Brecher (10), are due to a smaller amount of muscular involvement in maintaining one's posture during the experiment.

SUMMARY

The present study was designed to investigate further the effects of postural changes upon the visual perception of subjective verticality in the apparent frontal plane. Differing from most of the previous studies, this study tilted the body in the medial plane, i.e., forward and backward. Four different degrees of tilt were used in this plane, they were: -10°, 0°, $+10^{\circ}$, and $+45^{\circ}$. The stimulus rod rotated in the same plane as the body tilted in, i.e., the medial plane. It was adjusted by S to that position making both ends of the rod look equal distance from him in each of the four tilts.

In addition to noting the body tilt effect the variable of initial rod position was examined. Three different initial rod positions were administered in each of the four tilt positions.

Twenty four Ss, 12 male and 12 female were tested. They sat in a full length canvas contour chair in order to support the body without the involvement of any major muscles.

The main results showed that there was no significant effect of body tilt on the visual perception of subjective verticality in the apparent frontal plane. The position at which the stimulus rod was set initially did not significantly effect the setting of the rod. The two factor interaction of body position and sex appeared significant at the .05 level.

The results of the present study were discussed in the light of previous studies that had tilted Ss while noting the effect on their visual perception. The significant sex by body position interaction was discussed as well as the other non significant findings. Two graphs and an illustration (Figure II) were included to portray the findings...which suggested that it wasn't the degree of body tilt itself that caused the distortion of the subjective vertical but the degree of muscular involvement during the experiment.

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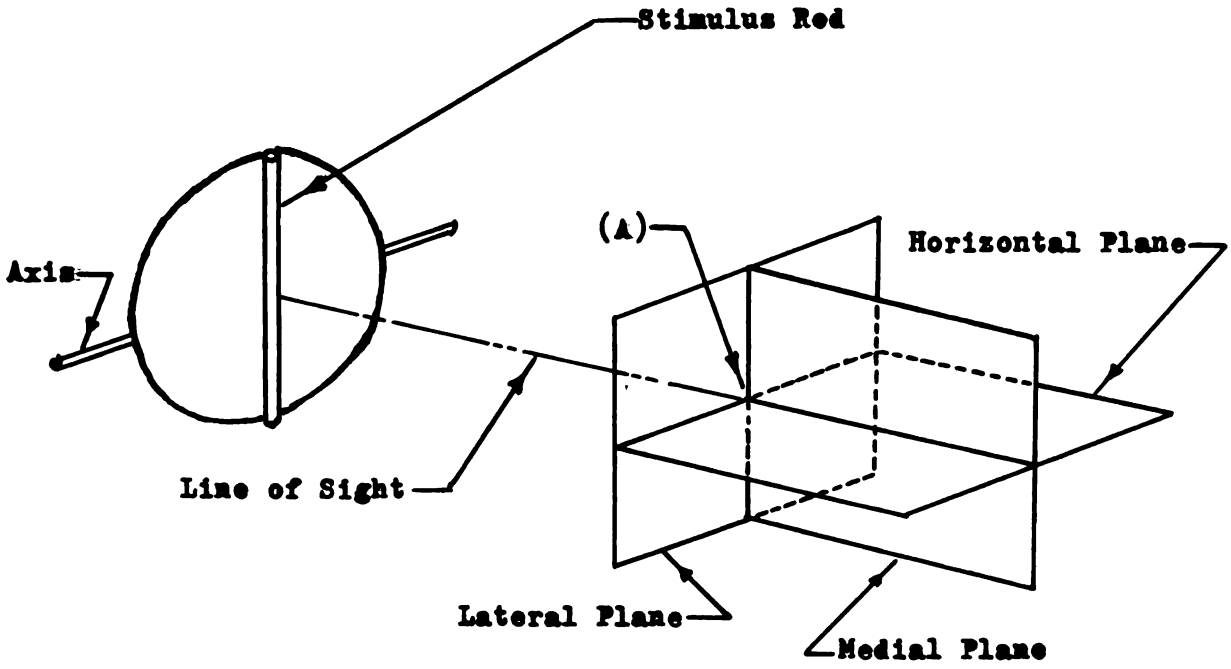
APPENDICES

Appendix A

Schematic diagram of the plane of rotation for the stimulus rod and other planes for descriptive purposes



Appendix A illustrates the stimulus rod, line of sight, and three major planes. S's eyes are considered to be at the intersection of the three planes (Point A). The stimulus rod rotated about the axis shown above so that its top came toward S while its bottom receded from S or vice versa. The true vertical was that position of the rod where both of its ends were equal distance from S.

Appendix B

Mean scores obtained for all test conditions (male and female Ss separately)

Male

Rod Position	Chair Position −10°	Chair Position 0°	Chair Position +10°	Chair Position +45°
−20°	−1.87	+0.19	+2.82	−0.74
0°	−2.41	−0.76	−0.74	−1.74
+20°	−0.96	+0.59	+1.99	+0.92

Female

Rod Position	Chair Position −10°	Chair Position 0°	Chair Position +10°	Chair Position +45°
−20°	+1.28	−0.37	+1.11	−2.64
0°	+2.15	+0.64	+1.73	−2.02
+20°	+0.16	+0.49	+0.75	−1.26