LIGHT INTENSITY AND PERCEPTION OF THE VERTICAL

Two experiments with the Rod-and-Frame Test

HELMUTH NYBORG

Institute of Psychology, University of Aarhus, Denmark

NYBORG, H. Light intensity and perception of the vertical: Two experiments with the Rod-and-Frame Test. *Scand. J. Psychol.*, 1972, *13*, 314–326.—Radical changes in light intensity of the visual field did not influence perception of the vertical appreciably as tested by means of a modified Rod-and-Frame Test apparatus in which the illumination of the rod and frame or of the frame alone was changed. Large individual differences in response to the Rod-and-Frame Test were found but little effect of changes in light intensity. A hypothesis that field dependent subjects would be more influenced than field independent by changes in light intensity of the rod and/or the frame was rejected.

Since Witkin & Asch developed the Rod-and-Frame Test in 1948 it has been used for many purposes; the apparatus has been applied to correlate perceptual style with several personality traits; clinicians have used it to test alcoholics, asthmatics and other hospitalized groups including mental patients; it has been applied in studies of occupational choice and in cross-cultural research. In some recent investigations the Rod-and-Frame Test apparatus has been applied in connection with studies of arousal, sensory deprivation, autonomic response pattern, physiological differentiation, tactile stimulation, and much more.

The broad application is understandable in light of the relatively easy administration of the test and the elaborated frame of reference in which the scorings according to Witkin et al. (1954) might be interpreted, i.e. in terms of field dependency and field independency. In fact, Witkin et al. (1962) relied very much on the Rod-and-Frame Test; their important considerations regarding a possible connection between perceptual style and personality drew heavily on the results from the test in combination with their studies by the Tilting-room/Tilting-chair Test and the Embedded Figures Test.

Such an extensive use of the Rod-and-Frame Test necessitates adequate description of the situational factors—physical as well as psychological—that determine the response of the subject. Warnings have been raised against easy interpretations of the results in simple frame dependency terminology, i.e. field dependency (Gruen, 1957; Mann & Boring, 1953; Gross, 1959; Weiner, 1955*b*; Cohen & Tepas, 1958; Lester, 1968; Howard & Templeton, 1966; Nyborg, 1971*a*, 1971*b*).

On this background it was decided to make an experimental analysis of some factors relevant for the Rod-and-Frame Test. It was not the intention to question the usefulness of the Rod-and-Frame Test as such, but rather to clarify some aspects of the test situation.

The first of a series of studies in the Rod-and-Frame Test was designed in order to clear up an old controversy regarding the light intensity of the rod and the frame in this test.

In the classical apparatus used by Witkin & Asch, and in most cases since then, the rod and the frame have been painted with luminous paint. Just before testing, the paint was activated by a lamp.

This procedure might be questioned for several reasons. First of all, one cannot be sure that the paint on the rod and the frame is stimulated equally in all parts and homogeneously from trial to trial, as activation of the paint in most cases was performed manually with a hand-lamp, and information has not been given in any of the investigations about this point. Next, as will be known to everyone who has used luminous paint in the dark, the radiance of light energy of the paint weakens continuously to an unknown degree during the experiment. The reduction in light intensity may have an effect opposite to that of the progressive dark-adaptation, but the total effect of these factors is not recognized. Finally, various qualities of luminous paint have possibly been used.

It is possible that contrasting results from several studies in the Rod-and-Frame Test might be at least partly explainable on this basis.

From an experiment similar to a rod-and-frame study, Boring (1952) thus concluded that the visual frame had no effect on perception of the upright. Mann (1952*a*) doubted that the frame in Boring's experiment had been 'strong' enough to exert measurable effect, and he intended to prove this. Unfortunately, Mann did not use a similar apparatus with a 'stronger' frame as the only variation in the experimental variables; instead, he made an experiment with a Tilting-room/Tilting-chair arrangement. He found that the visual frame exerted considerable influence on perceived vertical; but as this result is obtained in a situation quite different from Boring's modified Rod-and-Frame Test situation, it is incorrect to interpret the result as an indication that the visual frame was too weak in Boring's experiment.

Curran & Lane (1962) intended to study the effect of different illuminations of the visual field on perceived upright. They concluded that changes in illumination of the visual field had large and significant effect on perception of the upright. This conclusion will be discussed later in the report. However, it must be borne in mind that even here the apparatus was not similar to the Rod-and-Frame Test.

From most of these and other studies the general conclusion was drawn that the effect of the visual framework is stronger the more it is articulated. But still the question remained about the exact meaning of change of illumination in the Rod-and-Frame Test.

The purpose of experiment 1 was, therefore, to expose subjects to a Rod-and-Frame Test situation, in which the light intensity of the rod and the frame could be kept on a uniform and stabilized level over time, and in which the light intensity of the rod and the frame could easily be changed simultaneously to another similarly well-defined and stable level of intensity. It was expected that the effect of the tilted frame was enhanced as the light intensity of the field was increased. It was also expected that the effect would be different for so-called field-dependent and field-independent subjects.

Thus, in experiment 1 it was hypothesized that a subject would adjust the rod farther away from physical vertical under high levels of light intensity of the visual field than under low; furthermore, it was hypothesized that field-dependent subjects would be more susceptible to the changes in light intensity than field-independent.

The above-mentioned experiment 1 was performed in order to investigate whether *absolute* differences in levels of light intensity of both the rod and the frame were of importance for perception of verticality as measured in the Rod-and-Frame Test. Observed effects of changes in levels of light intensity might possibly explain discrepant observations in studies with the Rod-and-Frame Test and also with similar apparatus.

However, the meaning of *relative* differences in level of light intensity *between* the rod and the frame might also be questioned. To investigate this matter experiment 2 was performed in which the rod was kept at a mean light intensity level, while the light intensity of the frame was changed stepwise around this value. As in experiment 1, it was hypothesized that a high level of light intensity of the frame would affect adjustment of the rod to physical vertical more than a low level, and it was expected that this postulated effect would be more prominent in field-dependent subjects than in field-independent.

THE EXPERIMENT

Apparatus

The experimental apparatus consisted of a modified Rod-and-Frame set-up and a stand.

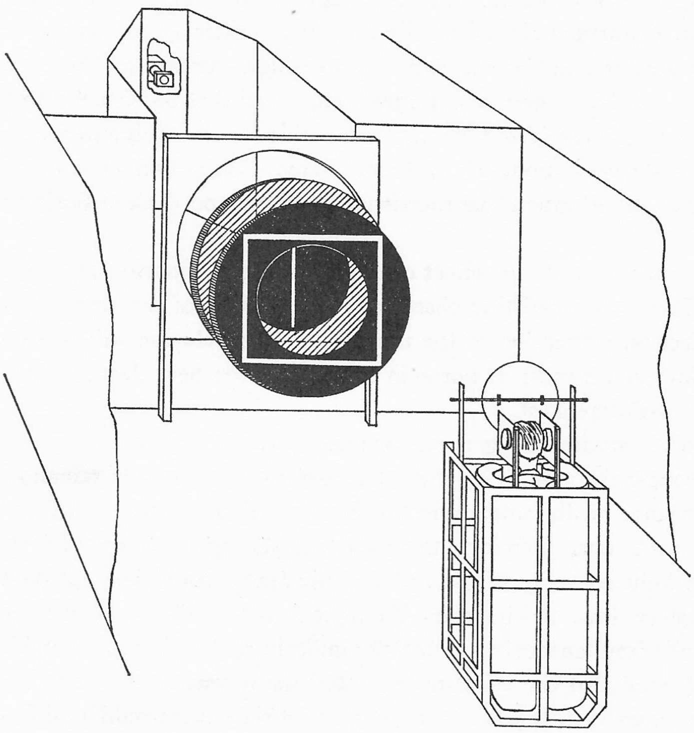

FIG. 1. The modified Rod-and-Frame set-up. The acrylic plates are not drawn in proper position in order to facilitate understanding of the function of the apparatus.

The Rod-and-Frame set-up

The Rod-and-Frame set-up is shown in Figs. 1 and 2. A wooden box with a front diameter of 1 620 mm was mounted on six steel legs in a height of 90 cm over the floor. In centre of the backside of the box a projector was placed on a shelf. The light from the projector could be directed through an aperture in the back wall of the box and across the box over a distance of 1 650 mm to reach the inside of the frontplate of the box.

The frontplate of the box was constructed of two circular plates with a diameter of 1 880 mm. The plates were made of 5 mm transparent acryl, on which 3 mm non-transparent black acryl was glued. The circular plates were stabilized by a rack-railway and could be moved 28° to the left and the right of physical vertical in the frontal plane by means of two motors. The speed of rotation was 1 revolution per minute.

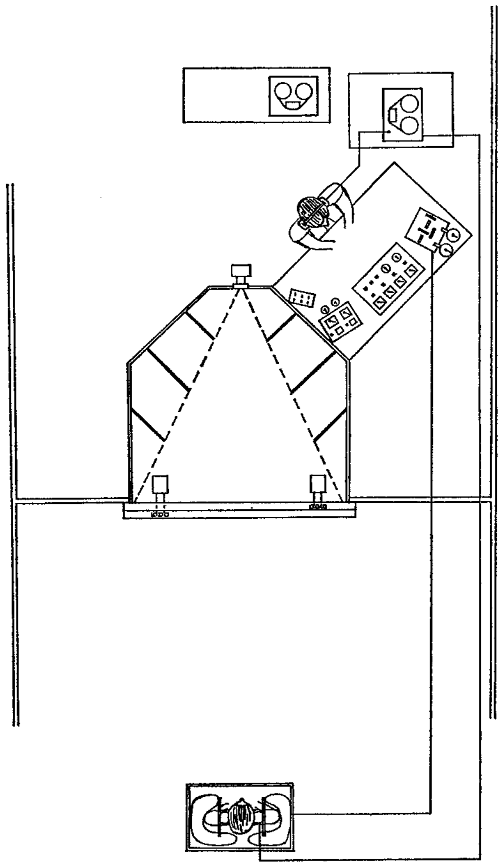

FIG. 2. The modified Rod-and-Frame set-up. Top-view.

When the light from the projector reached the backside of the front plates, it could penetrate only through the parts of the acrylic plates which were not covered with black acryl. As might be seen from Fig. 3, the pattern of light would then be made up to form a rod and frame configuration in which the rod and frame could be tilted independently of each other by remote control.

Readings and operations were performed in a light-proof control room, isolated from the test room. The degree of tilt of the rod and the frame could be read continually within 1°.

In this way it was ensured that light intensity was uniform in all parts of the frame and the rod. Furthermore, the light intensity was identical from trial to trial or it could be changed in a controlled way by use of Kodak neutral density filters.

The stand

The stand is described in details elsewhere (Nyborg, 1971 *a*). Furthermore, as it was kept in an upright position throughout the present experiment, it hardly needs more than a short description here.

It consists of a heavy steel framework in the form of an upright man-sized box with a gate in the front. The box was equipped with adjustable headrests mounted on a level with the subject's ears. Between the subject and the inside of the box hang two connected rubber cushions which could be inflated simultaneously; their function under inflation was to stabilize

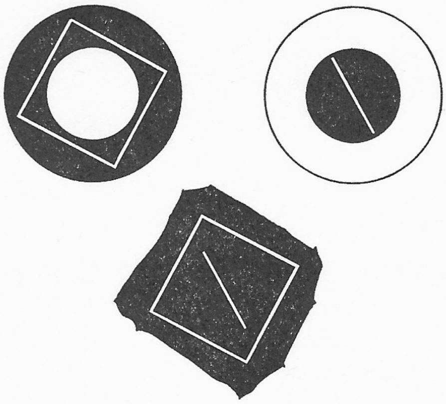

FIG. 3. When put close together and illuminated from behind the two acrylic plates at the top formed a pattern of light in the dark room as seen beneath.

the subject when standing erect so as to prevent body sway and make displacement between body and head axis impossible during the experiment.

Foot-rests of various heights could be inserted to compensate for individual body-height variations. Communication to the subject was maintained through ear-phones mounted in the head-rests, which—covered with foam rubber and sound-insulating material—excluded all unwanted auditive stimulation. A microphone allowed the subject to contact the experimenter.

When the experimenter put on the light from the projector, the subject could see the rod and frame at a distance of approximately 2.25 m. The centrepoint of the frame was about eye level of the subject.

The subject held remote controls in his hands. Pushing one button, he could turn the rod in one direction; if he pushed another button, the rod turned in the opposite direction.

Subjects

Fifty-six undergraduates (26 females and 30 males) served as subjects in sessions lasting about 45 min. No-one had any knowledge of the specific purpose of the experiment.

The experimental design

The subjects were divided into two experimental groups, each consisting of four subgroups of 7 persons. Both experimental groups proceeded according to a Latin Square design. In experiment 1, the first four subgroups were exposed to simultaneous changes in light intensity of the rod and the frame, i.e. when e.g. the light intensity of the frame was low, the light intensity of the rod was correspondingly low. In experiment 2 the other four subgroups were presented to changing light intensities of the frame, but with the light intensity of the rod kept at the same mean value in all trials.

In both experiments, the subjects were exposed to each of the seven light intensities under four conditions: frame tilted 28° left/rod tilted 28° left (a condition called counter clockwise/counter clockwise or CCW/CCW); frame tilted 28° left/rod tilted 28° right (CCW/CW); frame tilted 28° right/rod tilted 28° left (CW/CCW); and frame tilted 28° right/rod tilted 28° right (CW/CW). Thus every subject was scored under seven different light intensities and four tilt combinations of the frame and the rod, which gave a total of 28 scoring for every subject.

Procedure

To ensure the greatest possible difference between the lowest and highest level of light intensity and that the subjects were able to experience subjectively that each of the seven light intensities was distinct from all the others, care was taken to establish a subjective equidistant light intensity scale before the actual experiment began. The extremes of this continuum were determined in the following way.

TABLE 1. *Calculated filter density scale and actual filter densities applied in order to secure an approximated subjective equidistant light intensity scale with seven values. In right column is given a rough estimation of the stimulus light in lux at subject's place. For further explanation see text.*

Filter symbol	Calculated filter density (%)	Actual filter density (%)	Kodak Wratten filter combinations	Approximated light intensity at subjects place (lux)
A	80	80	ND 0.1	70.24×10^{-4}
B	17.89	16	ND 0.8	14.04×10^{-4}
C	4	4	ND 1 + 0.4	3.512×10^{-4}
D	0.9	0.9	ND 2 + 0.1	0.7902×10^{-4}
E	0.199	0.2	ND 2 + 0.7	0.1756×10^{-4}
F	0.044	0.05	ND 3 + 0.4	0.04390×10^{-4}
G	0.01	0.01	ND 4	0.00878×10^{-4}

Some fully dark-adapted subjects were placed in front of the Rod-and-Frame apparatus and the projector was put on. Under use of Kodak Wratten neutral density filters the illumination was progressively increased—with exposures adequately spaced over time—to an extreme point where some subjects could see reflection from the floor or ceiling of the experimental room which was completely darkened by black paint and curtains. The upper limit of the light intensity scale was then determined by use of the filter next darker to that applied at this point. The lowest limit was simply set by the last-but-one filter before all subjects reported that they could not see the rod and the frame anymore. Between these extremes, five other filters were selected so that all seven filter values were very nearly logarithmically equidistant. The result of this procedure is presented in Table 1.

In experiment 1 the filters were used in such a way that illumination of the frame corresponded to the illumination of the rod, i.e. if filter A was used for the frame, the same filter was used for the rod. In experiment 2, the rod always had a degree of illumination corresponding to the mean filter (*D*), but the illumination of the frame changed at random from trial to trial between filters *A* and *G*.

In both experiments the subject was first blindfolded, led into the experimental room and placed in an armchair, where he was to sit for 15 min to adapt to the dark. During this time, the footrest in the stand was adjusted corresponding to his height.

In the following 5 min, the subject was placed in the stand. The head rests were tightened, so that the subject could not move his head, and he was asked to keep his arms along his body but slightly forward. He was handed the remote controls for adjustment of the rod, the rubber cushions were placed in correct position, and the gate was closed. All light in the test room was turned off, and an assistant took off the subject's dark glasses. He was now told that the rubber cushions on both sides of him would be inflated. After this he received the instruction that in a few moments he would see a square frame, and within it a rod. The possible tilt combinations of the rod and frame were explained, and he was instructed that his job was to adjust the rod to physical vertical. It was ensured that he understood clearly what was meant by 'vertical' through definitions like 'vertical as the walls of this building'; 'like the flagpole'; 'like a plumb-line hanging just before your nose' etc. When these instructions were given, the rod and frame were placed in position for the first trial, and the correct filter inserted according to the protocol. Until now, the subject had been in the dark for 20 min.

The rod and frame were then illuminated and the subject was asked to report on the position of the rod and frame. If he at once perceived the rod as vertical, he was examined very carefully to ascertain that he really perceived the rod as physically upright and not in relation to the frame. If he reported that the rod was tilted, he was asked himself to adjust the rod by means of the remote controls which he held in his hands, until he perceived the rod as vertical, in which case he was to say 'enough'. At this point the subject was allowed to adjust further if he wanted.

The subject was now again questioned, to make sure that he perceived the rod as upright, if he meant that the rod was now parallel to the walls of the building. The light on the rod and frame was put out, and the position of the rod relative to physical vertical was read in the adjoining control room. Rod and frame were adjusted for the next trial and illuminated, and the subject was asked to proceed again.

In the first trials the questions of vertical were repeated to ensure that the subjects really understood the meaning of physical vertical.

ANALYSIS

All deviations from physical vertical in adjusting the rod to vertical were recorded, i.e. when the subject adjusted the rod to a position in which he accepted it as being physically vertical, the position of the rod was noted in degrees without regard to the direction of deviation from physical vertical.

Analysis of variance was made for intersubject differences, order of treatment, and effect of shifts in light intensity. Scorings were analysed with regard to the four possible tilt combinations of the rod and the frame. Furthermore the material was analysed for possible differences in susceptibility to the effect of light intensity changes between individual subjects as well as differences between groups of high-, middle-, and low-scoring subjects.

The analyses were based on 1 568 estimations made by the 56 subjects.

RESULTS

Experiment I

Table 2 presents the analyses of variance for all 28 subjects in this experiment and is concerned with intersubject differences, order of treatment, and effect of changes in light intensity with regard to scorings in situations where the frame and the rod were tilted CCW/CCW; CCW/CW; CW/CCW; and CW/CW respectively.

As seen from the table, individual differences in capacity to adjust the rod to physical vertical were remarkable under all given conditions as mirrored in a high level of significance ($p=0.001$) under all tilt conditions.

In view of the facts that a subject was exposed to 28 trials in a row, it was expected that learning effect might show up during the experiment. In experiment 1 no learning effect actually occurred, and only one tilt condition in experiment two (CCW/CCW; $0.001 < p < 0.01$, cf. Table 3) shows this effect. Thus the importance of learning was generally considered negligible, as earlier shown by Elliott & McMichael (1963).

Quite contrary to what had been expected, the effect of simultaneous changes of light intensity of the rod and the frame was seen under one tilt combination only (CW/CW; $p=0.001$; cf. Table 2).

TABLE 2. *Results of analysis of variance, Experiment I.*

Source of variance	Degrees of freedom	Sum of squares	Mean square	F	
Intersubject differences	27	1 497.12	55.45	16.53***	CCW/CCW (see text)
Order of treatment	6	28.05	4.68	1.40	
Light intensity	6	27.34	4.56	1.36	
Error	156	522.61	3.35		
Intersubject differences	27	463.16	17.15	4.68***	CCW/CW
Order of treatment	6	37.55	6.26	1.71	
Light intensity	6	21.27	3.54	0.97	
Error	156	571.76	3.67		
Intersubject differences	27	1 547.24	57.31	11.99***	CW/CCW
Order of treatment	6	9.78	1.63	0.34	
Light intensity	6	55.63	9.27	1.94	
Error	156	745.73	4.78		
Intersubject differences	27	2 760.39	102.24	25.71***	CW/CW
Order of treatment	6	16.82	2.80	0.70	
Light intensity	6	108.60	18.10	4.55***	
Error	156	620.30	3.98		

* Significant at the 0.05 level.
** Significant at the 0.01 level.
*** Significant at the 0.001 level.

Thus no convincing picture was developed of the importance of changes in light intensity for perception of vertical as measured under the light conditions in experiment 1, when the results from all 28 subjects were lumped together in this way.

The data were then analysed on the basis of the subject's mean deviations in degrees in setting the rod to physical vertical by dividing the subjects into three groups: group I with subjects having mean scores between 0 and 1.9° ($n=4$); group II with scores between 2 and 3.9° ($n=12$); and finally group III with scores of 4° or higher ($n=12$).

The analysis was made in form of graphs in which light intensity values were set out of the abscissa; up the ordinate the average deviation of the group in question was marked in degrees. The results are given in Fig. 4.

Generally there was a weak tendency to adjust the rod nearer to physical vertical when the illumination of the visual field increased, but the main impression from the figure is that the effect of changes in light intensity was weak under all tilt combinations.

But the main point was to see if different scoring groups were variously influenced by changes in illumination of the visual field. This seems not to be so. When the curves in Fig. 4 are compared it is seen that the slope of the curves is generally much alike in group I, II, and III.

The impression from Table 2 that differences in absolute level of light intensity in the Rod-and-Frame Test are of minor importance is thus supported also when the data are analysed with regard to subjects divided in 'low-scoring', 'intermediate-scoring', and 'high-scoring' groups.

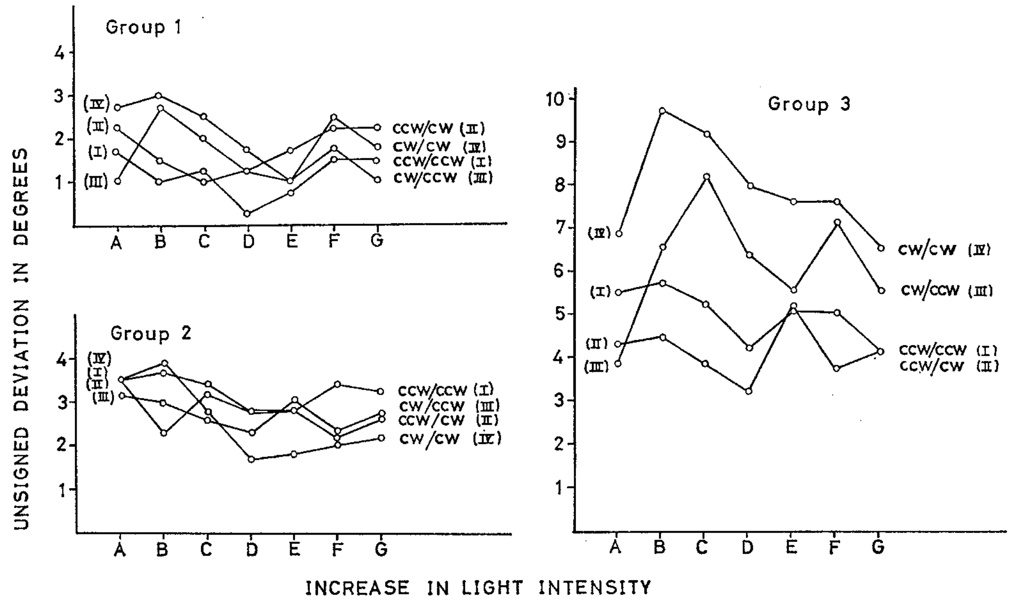

FIG. 4. Perception of verticality in relation to different levels of light intensity of the rod *and* the frame in experiment 1. The points in the diagrams represent the unsigned mean deviation in degrees in setting of the rod to physical vertical under seven subjective equidistant light intensities. Groups I, II, and III refer to subjects with mean scores of 0–1.9°; 2–3.9°; and 4° and more, respectively. For explanation of CCW and CW see text.

Experiment II

As will be remembered from experiment one, the illumination of the rod and the frame was changed simultaneously. In experiment two, the illumination of the rod was kept at a mean value while the illumination of the frame was alternated at random between seven values.

Table 3 presents analysis of variance for the 28 subjects, none of whom had participated in experiment 1. Again considerable individual differences were observed in response to the Rod-and-Frame Test situation ($p = 0.001$ for all tilt combinations, cf. Table 3.).

Different levels of light intensity of the frame, however, did not influence the setting of the rod to vertical to any considerable degree. Under tilt combination CW/CCW the adjustment of the rod was only under observable influence, and then, although statistically significant ($p = 0.01$; cf. Table 3) not persuasive enough to indicate a general effect from changes in level of light intensity of the frame, while the illumination of the rod was held constant.

As in experiment one, the data were analysed graphically for groups I, II, and III.

TABLE 3. *Results of analysis of variance, Experiment II.*

Source of variance	Degrees of freedom	Sum of squares	Mean squares	F	
Intersubject differences	27	3 663.24	135.68	16.60***	CCW/CCW (see text)
Order of treatment	6	108.53	18.09	2.21**	
Light intensity	6	84.24	14.04	1.72	
Error	156	1 275.22	8.17		
Intersubject differences	27	3 055.73	113.18	18.48***	CCW/CW
Order of treatment	6	73.69	12.28	2.01	
Light intensity	6	29.55	4.93	0.80	
Error	156	955.61	6.13		
Intersubject differences	27	3 040.42	112.61	14.96***	CW/CCW
Order of treatment	6	74.17	12.36	1.64	
Light intensity	6	145.60	24.27	3.22**	
Error	156	1 174.22	7.53		
Intersubject differences	27	4 165.61	154.28	25.19***	CW/CW
Order of treatment	6	13.36	2.23	0.36	
Light intensity	6	78.50	13.08	2.14	
Error	156	955.29	6.12		

* Significant at the 0.05 level.
** Significant at the 0.01 level.
*** Significant at the 0.001 level.

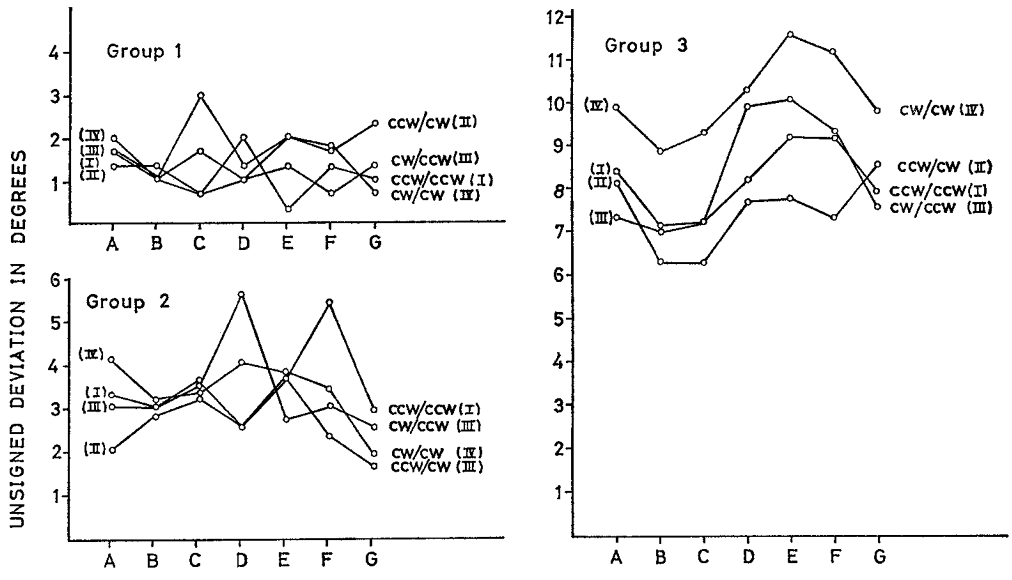

FIG. 5. Perception of verticality in relation to different levels of light intensity of the frame while level of light intensity of the rod was kept at a mean value in experiment 2.

When the curves in Fig. 5 are compared with those in Fig. 4 (experiment 1), it is seen that the slope is rather similar.

Result from experiments 1 and 2 seem thus on the whole to be in accordance. Differences in level of illumination do not seem to exert any influence on perception of the vertical in the Rod-and-Frame Test. This observation holds true both when the total visual field, i.e. the rod *and* the frame, and when only part of the field, i.e. the frame *alone*, change their light intensity within rather wide limits.

These results could not be due to complete ignorance of changes in light intensity in the two experiments.

From the protocols it is seen that all subjects except four reported in a post-experimental interview on the question if they observed anything that changed from trial to trial besides the tilt of the rod and the frame that the level of light intensity changed. The 4 subjects who did not report on shift in illumination experienced that the rod and frame were moved nearer to or farther away from themselves.

We may then conclude that the expected effect of changes in light intensity of the visual field on perception of the vertical in the Rod-and-Frame Test did not turn up in sufficient degree to support the hypotheses either in group or in individual scores, and neither when the illumination of the total field was changed, nor parts hereof.

DISCUSSION

The earlier criticisms directed against Boring's study that the visual field in his experiment had not been 'strong' enough cannot, following the above-mentioned conclusion, be explained on basis of a too 'weak' illumination and thus other factors must be related to the fact that Boring could not localize any field-dependent subjects.

Furthermore, differences in light intensity between various Rod-and-Frame Test apparatuses, and also the progressive reduction in light intensity—unavoidable when luminous paint is used—are of little importance for scoring in the Rod-and-Frame Test and might not constitute a basis in explaining different results in various studies.

The effects of the progressive dark-adaptation, which is inevitable when subjects carry out the Rod-and-Frame Test even after a few minutes in the dark, might be without importance.

It does not play a significant role for adjustment of the rod if there are relative differences in the level of light intensity between the rod and the frame.

Finally, it was observed that there were no differences in susceptibility to changes in light intensity between field-dependent and field-independent subjects.

But Curran & Lane found, as already cited in the introductory remarks, large and significant effects on perception of vertical when they changed the illumination of the visual field to a lesser degree than in the present experiment. This result stands apparently in sharp contrast to ours.

It might, however, tentatively be suggested that the experiment of Curran & Lane was not primarily a study in the effect of changes in illumination but rather one in visual acuity. The visual field in their experiment was composed of a piece of linear graph paper, 8 inches square, with blue lines heavy-ruled at 1 inch intervals and light-ruled at 0.1 inch intervals. The lines were aligned with true vertical.

When the subject could not see the lines he found it very difficult to set the rod physically upright; as soon as the illumination was increased to a point where he could perceive the lines even dimly, the "relatively few visual cues to the vertical can yield extremely accurate estimates of the vertical ..." (Curran & Lane, 1962, p. 298).

It is very plausible that a subject can easily set a rod parallel to visible lines. This is a task of comparison. And as long as he perceives the lines it is of little consequence if the illumination of the field is increased considerably. Also, as long as the subject cannot perceive the lines of comparison of the field it does not matter if the illumination is varied considerably.

It might therefore be suggested that the main variable in Curran & Lane's experiment was not changes in illumination *per se* but rather if the subject could or could not perceive some lines with which to parallel the rod. Changes in illumination in their experiment was only important around the point where the comparison-lines became visible or disappeared. It is of course a different question, if the structure of the visual field is changed. If Curran & Lane, thus, by 'change of illumination' of the visual field meant 'change in the structural complexity', in which the degree of illumination certainly have some importance as long as it might alter the visible structure, it is then reasonable to think that a complex field might influence perception of the vertical more than a less complex.

Following this interpretation of Curran & Lane's experiment, their result no longer contradicts the present. And it has been shown by Witkin & Asch (1948*b*) and Witkin et al. (1962) in an extensive series of studies that the structural complexity of the visual field highly influences the estimation of the vertical.

Thus they demonstrated that a luminous frame in the Rod-and-Frame Test caused a mean error of about 6° off physical vertical; the Tilting-room Tilting-chair Test (in which a room with complex structures was tilted) gave rise to a mean deviation of 14.9° on an average; and the Mirror-situation (where a full natural scene was tilted) caused 22° deviation from physical vertical on an average.

In line with this it makes sense to regard the structural complexity of the visual field as highly important for the perception of vertical in general. As it now has been shown that changes in the degree of illumination of the visual field in the Rod-and-Frame Test are not critical within rather wide limits for perception of the upright, the next step should be to investigate what influence frames of different structural complexity might have in the Rod-and-Frame Test by use of interchangeable configurations of different structure. Such an investigation is planned.

The author is indebted to Søren Keldorff and Carsten Fonsmark for help in carrying out the experiments.

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H. Nyborg
Psykologisk Institut
Aarhus Universitet
Asylvej 41
82 40 Risskov
Denmark

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Denmark