

A STUDY OF THE PERFORMANCE OF A BANTU SAMPLE
ON A TEST OF PERCEPTUAL FIELD-DEPENDENCE
UNDER CONDITIONS OF NORMAL AND ABNORMAL
SENSORY ENVIRONMENTS

by

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TABLE OF CONTENTS

<u>CHAPTER</u>	<u>TITLE</u>	<u>PAGE</u>
I	THE DEVELOPMENT OF THE CONCEPT OF FIELD DEPENDENCE	1
	STAGE I	2
	STAGE II	8
	STAGE III	11
	STAGE IV	15
	STAGE V	17
II	FIELD DEPENDENCE AND ABNORMAL SENSORY ENVIRONMENTS	18
	1. Differences in the Reaction to Sensory Deprivation	18
	2. Effect of Sensory Restriction on Field Dependence	20
III	CROSS CULTURAL STUDIES IN THE FIELD DEPENDENCE-INDEPENDENCE DIMENSION	22
IV	RESEARCH DESIGN AND EXPERIMENTAL PROCEDURE	25
	1. Aim and Hypotheses	25
	2. Research Design	25
	Treatments	27
	Samples	27
	3. Experimental Procedure	28
V	THE ADAPTATION OF TEST MATERIALS AND INSTRUCTIONS TO THE BANTU SAMPLE	33
	1. Modifications and Innovations to Test Materials	33
	2. Development of a New Set of Test Instructions	36
VI	TESTS FOR ARTIFACTS AND RELIABILITY	40
	1. Artifacts	40
	2. Reliability	45

<u>CHAPTER</u>	<u>TITLE</u>	<u>PAGE</u>
VII	STATISTICAL TREATMENT OF DATA	47
	1. Heterogeneity of Variance	47
	2. Tests for Normality	47
VIII	SIGNIFICANCE OF THE FINDINGS	51
<u>APPENDICES</u>		
A	DESCRIPTION OF THE VARIOUS ORIENTATION TESTS EMPLOYED BY WITKIN ET AL	56
B	SETTINGS OF CHAIR FOR PRACTICE AND TEST TRIALS	61
C	ROD AND FRAME TEST INSTRUCTIONS WITH TYPICAL RESPONSES BY SUBJECTS	62
D	NORMALITY PLOTS OF DISTRIBUTIONS	70
E	RAW DATA	73
F	DIAGRAM OF HYDRAULIC SERVO MECHANISM	76
	BIBLIOGRAPHY	77

CHAPTER I

THE DEVELOPMENT OF THE CONCEPT OF FIELD DEPENDENCE

For purposes of this background study, previous research findings relating to the development of the concept of field dependence - independence may be traced in five clearly distinct and logical stages:

Stage I The Determination of the Factors Responsible for the Maintenance of Proper Orientation to the Upright.

Stage II The Investigation of Individual Differences in the Manner of Establishing the Upright.

Stage III The Consideration of Possible Hypotheses to Account for Consistent Individual Differences in this Mode of Perception.

Stage IV An Investigation of the Relationship Between an Individual's Characteristic Way of Perceiving and his General Personality Organisation.

Stage V The Ultimate Extension and Elaboration of this Work into the Construct of Psychological Differentiation - which proposes that individuals are likely to function at a more differentiated or less differentiated level in many areas of behaviour.

Some discussion of these stages is necessary to provide background for the present study. The last two stages are primarily concerned with the integration of perception and personality into what may be described as a "personality-perception typology". The first three stages are more concerned

with the perceptual aspects involved in space orientation, have greater relevance, and accordingly these findings are set out in some detail.

Stage I The Determination of the Factors Responsible for the Maintenance of Proper Orientation to the Upright

The concept of field-dependence emerged initially from a series of studies of perception of the upright in space by Asch and Witkin (1948a, 1948b); Witkin and Asch (1948a, 1948b); Witkin (1950).

From their early investigation Witkin and Asch determined that the ability to establish the upright as quickly, accurately and effectively as we normally do is based upon, as Witkin himself so aptly puts it:

" . . . the stable and compelling representation of the vertical (upright) in our surroundings and upon our possession of the adequate sensory equipment for its detection".

They concluded that when a strong visual field is present, the perceived upright is determined with relation both to (1) the axes of that field and to (2) gravitational impressions received from the body, with visual factors playing the dominant role. Firstly, the general visual environment filled with prominent verticals and horizontals provides a ready basis for establishing the upright, since it has the character of a framework whose main dimensions represent the true vertical and horizontal. Secondly, gravitational force and direction, which correspond to the true vertical, are readily apprehended through continuous postural adjustments made to this force; through proprioceptive impact made from muscles, tendons and joints, as well as through other labyrinthine cues.

While perception of the upright depends on these distinct entities or sources of information we do not have in our experience

distinct conceptions of the upright, one visual and the other postural. Our experience of these two sets of factors is ordinarily fused, resulting in a common or unified impression of the upright. Furthermore, since the visual and gravitational uprights are coincidental in direction, the resulting response is the same, under normal sensory conditions, regardless of which determinant is used as the main basis for perception.

Hence, the task of determining the direction of the upright may present itself in the following different, though not necessarily exclusive, ways:

- (1) The direction of the field as a whole must be determined, e.g. whether the cockpit of a plane in a cloud bank, which obliterates all external dimensions, is level.
- (2) The direction of an object within the field must be determined, e.g. whether a support for an overhead beam is straight or whether the beam itself is level.
- (3) The position of the individual's body in relation to the upright must be determined, e.g. whether it is erect or tilted at any given moment in time.

The tests used by Witkin and Asch were developed to present all perceptual conditions under which orientation to the upright may be investigated.

The respective roles of the visual and postural sense modalities were studied by techniques which permitted their separation as well as variations in the relation between them. Each test presented the problem of integrating effectively a variety of visual and postural sensory

experiences, kinaesthetic, cutaneous, visceral and labyrinthine.

Brief functional descriptions of the Main Orientation Tests employed by Witkin et al are presented below.

Details of description, conditions, administration and scoring of the tests are presented in Appendix A.

(a) The rod and frame test (RFT)

Function

This test was used to evaluate the individual's perception of the position of an item in relation to the upright within a distracting visual reference frame.

For successful performance of this task the subject was required to "extract" the rod from a tilted frame through reference to body position.

(b) The tilting-room - tilting chair tests (TRTC)

Function

These tests, the body adjustment test (BAT), and the room-adjustment test (RAT), were used to assess an individual's ability to relate the perception of his body and of the whole surrounding field to the upright.

(c) The rotating-room test

Function

This test evaluated the subject's perception of his body and his surroundings when the direction of the force acting on his body had been changed.

Phenomenology of Space Orientation

Some phenomenological aspects of space orientation resulting from findings on the above tests deserve comment at this stage since they will

contribute to an understanding of the groupings which the various sub-tests may assume. The sub-tests may be grouped into two major categories:

- (1) those involving the subject's perception of the position of the field itself
- (2) those testing his perception of an item within the field.

The room adjustment series of the tilting-room-tilting chair test (Series 1a and 1b) and of the rotating-room test (Series 1) represented field-as-a-whole tasks. The three series of the rod and frame test, the two chair-adjustment series of the tilting-room-tilting chair test (Series 2a and 2b) and the chair adjustment series of the rotating room test (Series 2) represented item-within-a field tasks.

In the field-as-a whole type of situation the subject could simply accept the field as upright or approximately upright in its initial position, without any further effort. On the other hand, he could attempt to determine the position of the field by relating it to the only standard available - the position of his body as he feels it. The latter was certainly more active, analytical procedure than the former. The main factor in this procedure was that perception of the body had to be kept effectively apart from that of the field and hence was designated as "keeping-item-and field separate".

In part-of-the-field tasks, both kinds of procedure were also possible. However, the nature of the task presented placed relatively strong emphasis on an active "keeping-item-and field separate".

Test instructions focussed attention on the item to be straightened rather than upon the field itself. Item-within-a field tasks strongly encourage analysis. One would expect measures of performance in situations within each category, viz field-as-a-whole and item-within-a-field tasks to bear a closer relation to each other respectively than to measures of performance in situations of the other category.

An important difference between part-of-a field tasks involving the body and those involving the rod should be noted. In the former, the subject was presented with a relatively simple and unitary perceptual system consisting of a field within which was his body, the item of perception. Perception of the item was influenced by the field on the one hand, and on the other hand the body provided stimulation that could be used as an aid in isolating it from the field. In contrast to this the rod and frame test presented what was more nearly a "two system" perceptual situation. The object of perception, the rod was within the field of the frame which was its immediate context for perception; this was the one system. The relevant standard for determining the position of the rod-and-frame systems, the subject's body could have been regarded as a second perceptual system. The effort to keep the object of perception, the rod, separate from the field was not aided by the object itself as happened when the body was the object of perception. The success of this effort depended on the rather indirect procedure of relating the position of the rod to the felt position of the body. This was something particularly difficult when the body was tilted (Series 1 and 2) and allowances had to be made for its tilt in the determination of the upright. Separating the rod from its context was thus found to have been more difficult than separating the body from its context.

A further pursuit of this sort of analysis, in terms of the extent to which the structure of the task facilitated or hindered the "keeping item-separate-from-field" procedure, revealed internal distinctions among the different tasks of the rod-and-frame test itself and also among the various body-adjustment tasks.

In the rod and frame tests, a difference was found between Series 1 and 2 on the one hand, and Series 3 on the other. In Series 1 and 2 the body was tilted, and thus to utilise it in establishing the position of the rod, the

subject had to negotiate the important intervening step of making proper "allowance" for the magnitude of its tilt. In Series 3 on the other hand, the body was erect so that it was possible to relate the rod directly to the body by lining the two up which aided the process of isolating the rod from the frame. Because "keeping-item-separate-from-field" was thus greatly facilitated, mean performances in Series 3 were of smaller magnitude than in either Series 1 or 2. Results in Series 3 were more closely related to results in body adjustment series, (than to Series 1 or 2).

Differences were also found between Series 1 and 2 although both involved a tilted position of the body. In Series 1 the subject's body was tilted the same amount and to the same side as the frame so that they were in fact aligned. This made it possible, even though rod and frame were perceived as straight to determine that they were tilted, and to estimate how much simply by referring to the position of the body. In Series 2, on the other hand where body and frame were tilted to opposite sides, body position could not be of direct use in helping to establish the position.

The general findings obtained from these studies indicated that, tilting the visual field, even with the body erect, produces errors in the perception of the upright, in the direction of the tilt of the field. Conversely, tilting the body while the field remains upright does not disturb orientation at all, the upright being established with the usual precision. Tilting both the body and the field leads to the most serious errors, again in the direction of the tilt of the field. Finally, the tilted visual field tends to become phenomenally upright upon prolonged observation. These findings demonstrated that perception of the upright, within the population studied, is markedly anchored to the visual field.

Consequently in 1954 Witkin and his colleagues (Witkin, Lewis,

Hertzman, Machover, Meissner and Wapner) introduced the construct "field dependence" to refer operationally to:

"the marked inability of some persons to make a judgement of verticality on the basis of kinaesthetic cues when they are faced at the same time with visual cues".

Stage II The Investigation of Individual Differences in the Manner of Establishing the Upright

Studies of performance on tests used in Stage I demonstrated marked individual differences in the extent to which location of the perceived vertical was determined. Specifically, individuals differed with regard to the relative emphasis assigned to visual impressions and to bodily experiences in the final integration. It was found, in addition, that individuals tended to be consistent in their performance of perceptual functioning among a variety of such tests. An investigation of these individual differences forms the second stage in the development of the concept of field-dependence.

The nature and extent of these differences in perception are discussed briefly for each of the three tests.

(a) RFT

When asked to adjust the rod to the upright most subjects displaced it in the direction of the tilt of the frame. When individual performances are considered, however, it was found that people differed markedly in the extent to which they were affected by the frame. Some subjects were able to escape the influence of the frame, both with body erect and with body tilted and succeeded in bringing the rod to within a few degrees of the true upright. The ability to perceive the rod

independently of the field, or to deal with the presented visual situation analytically, undoubtedly reflects the effective use of body experiences as a basis for perception. Other subjects on the other hand based their perception of the upright almost exclusively in relation to the frame. Between these two extremes lay a third group who orientated the rod to a position which represented some degree of compromise between the vertical of the tilted field and the vertical indicated by the body.

Among subjects whose perception depended markedly upon the frame a striking phenomenon was observed. At times, in the absence of any actual movement, the subject would experience a perceptual shift in the axes of the frame so that its top most side would be perceived as one of its sides. When perception of the frame showed this kind of lability, alignment of the rod with the displaced axes led to exceedingly large errors in estimation of the upright.

(b) The tilting-room - tilting-chair test

(a) RAT

The general trend here was for subjects to go along with the field so that the perceived upright was shifted toward the vertical of the tilted room. Some subjects merely identified the true upright with the vertical of the room, perceiving the room at the outset as fully erect at its initial tilt of 56° .

Others located it somewhere between the vertical of the room and the vertical indicated by experiences of body position and moved the room from its initial tilt to some position closer to the true vertical.

A few subjects were successful in bringing the room to the true vertical, indicating that they had judged the upright independently of the

field and in accordance with postural cues.

(b) BAT

Striking differences were obtained in this sub-section of the tilting-room tilting chair test as well. Most subjects tended to "straighten" the body in the direction of the tilted room, indicating that they had been influenced by visual sensory input. They moved the body to some position intermediate between the true upright and the vertical of the tilted room.

Some subjects, on the other hand, succeeded in bringing their bodies to the true upright, regardless of the position of the room, basing their judgements entirely on bodily sensations.

Still others, at the opposite end of the continuum, moved their bodies into complete alignment with the tilted room, indicating that the visual basis of judgement alone was being used and that no integration was taking place with bodily sensations.

(3) The Rotating-Room Test

A large degree of variability was again reported among subjects on this test, depending, as before, on differences in the manner of integrating visual and postural impressions. When asked to adjust themselves to the upright some subjects moved themselves to positions at approximately 90° to the force compensating for it thus in full. These subjects moved the room to an equally marked extent; for them the force experienced by their bodies was the main determinant in perceiving both body and field position. The opposite extreme was demonstrated by some subjects for whom the room continued to appear fully upright throughout rotation and who therefore did not need to move it at all. It may be concluded that under the same field conditions

and with a force of the same magnitude and direction acting on their bodies, people markedly differ in their mode of perception of the upright.

Stage III The Consideration of Possible Hypotheses to Account for Consistent Individual Differences in this Mode of Perception

The next logical step in this field of experimentation was a consideration of possible hypotheses to account for the above reported consistent individual differences in mode of perception.

Witkin et al (1962) considered three initial hypotheses:

- (a) "Accuracy" in perception of the upright.
- (b) Body sensitivity.
- (c) The overcoming of an embedding context.

The rationale underlying the rejection of the first two hypotheses, and the acceptance of the third which was found to be the most tenable, is now briefly considered.

(a) The "accuracy" hypothesis

This hypothesis interpreted individual differences in terms of "accuracy" in perception of the upright.

The principal evidence against this hypothesis was contributed by results from work done with the rotating-room test described earlier. Witkin derives his logic for the rejection of this hypothesis from the following considerations:

The room in which the subject was seated - the surrounding visual field - in the rotating-room test remained upright throughout rotation. In the body adjustment test, however, the visual field was displaced from the upright while the direction of the force on the body remained unchanged.

In other respects, these two tests were directly comparable.

Hence, if "accuracy" were the important determinant of individual differences in perception of the vertical in these tests, one would expect a high degree of positive agreement between the scores of these two tests. In practice, however, high negative correlations (0.66 for men and 0.72 for women) were obtained, indicating that the "accurate" perceivers in the BAT tended to be among the most inaccurate perceivers in the rotating-room test and vice versa.

(b) The body sensitivity hypothesis

When only the results of the orientation tests were available, it was apparent that some people determined the upright with reference to the visual field (field dependent) while others determined it primarily with reference to bodily sensations (field independent). Considered in these terms, it seemed possible that the field-independent person might have great sensitivity to body cues while the field-dependent might have little sensitivity.

Early findings with a series of tests involving body action and body perception contributed to the rejection of the "body sensitivity" hypothesis.

Performances in test situations using the ataximeter (body steadiness) and stabilometer (body balance) which sensitively measure body cues, Wapner and Witkin, (1950) and Witkin and Wapner (1950), were found to have little relation to performance in the tests of space orientation.

In addition, accuracy in adjusting the body to the vertical from an initially tilted position with body surrounded by a tilted visual field - the task in the BAT - was found to have little relation to accuracy in

carrying out the same task with the eyes closed, i.e. in the absence of a visual field. Scores for "eyes closed" version correlated 0.23 for men and 0.20 for women (neither significant) with standard BAT scores. Since the "eyes closed" BAT evaluates directly the ability to utilize body sensations of tilt in orientation the low and non-significant correlations suggest that body sensitivity as such could not account for the striking differences among individuals in body-adjustment test performance.

The standard BAT conducted with eyes open (under influence of visual field) was found to be more highly related to the embedded figures test, EFT (to be described below) which does not involve body position at all, than to the BAT conducted with eyes closed.

Fairly high significant correlations were found between scores for the standard BAT and EFT (.54 for men and .58 for women) in contrast to the low correlations cited above between the standard BAT and its corresponding "eyes-closed" version.

It may be concluded from the above evidence, therefore, that an hypothesis of sheer alertness to cues of body tilt will not account for observed individual differences in the ability to adjust the body to the vertical under the defined conditions.

(c) Ability to Overcome an Embedding Context

The embedded figures test (EFT) was developed to assess an individual's ability to perceive an item independently of its context and involved neither orientation towards the upright nor body position.

The subject's task was to find a particular simple figure within a larger complex figure. The simple figure was "hidden" by being incorporated into the pattern of the larger figure, e.g. its outlines could have formed

the boundaries of several prominent sub-patterns in the complex figure.

Witkin et al (1954) found the EFT to be highly related to the BAT and RFT and moderately related to the RAT.

Linton (1952), Gruen (1955), Young (1959) and Gardner, Jackson and Messick (1960) also found supporting evidence in this line.

Correlations among scores for the BAT, RFT and EFT were found to be significant in most cases, giving a picture of substantial consistency in individual functioning in these tests.

This data supported the hypothesis that it was the ability to overcome an embedding context which was the factor common to these tests.

The finding of these significant relationships between performance in the orientation tasks and performance in the embedded figures test (as well as other non orientation tasks) had thus helped Witkin and his co-workers define more precisely the nature of the individual difference which they had observed.

With only the results of the orientation tests available, they had characterized perception in terms of ordinary reliance on either bodily sensations or the visual field. Now they had a broader basis of classification. In each case now the experimental situations required the individual to separate some item: rod, body, or simple geometric figure from its background or context; to "break up" and analyse a given situation; to maintain an active "set" against the influence of the surrounding field.

Those individuals who showed a capacity to differentiate objects from their backgrounds in this way were termed "field-independent". Conversely, "field-dependent" subjects formed that group whose performance reflected relatively passive submission to the domination of the background

and who were unable to differentiate or separate an item from its surroundings. It should be noted that these two classifications form the opposite ends of a continuum and are neither value judgements nor do they form separate entities. (The graphical distribution of scores on these tests approximated a normal curve).

On the basis of this more comprehensive definition Witkin et al were able to deduce much more about characteristic styles of perceiving and extended their experimental work into the personality, and developmental domains of psychology.

Stage IV An Investigation of the Relationship between an Individual's Characteristic Way of Perceiving and his General Personality Organisation

Having discovered systematic individual differences in perceptual style, Witkin and his co-workers related these styles to types of behaviour. Analytic, field independent types were considered to perceive the self as more distinct, more differentiated from surrounding social relations than did field dependent types. Such people were more individualistic than field dependent persons and this was hypothesized to have arisen from the type of parental socialization practices they experienced. Field dependent people were more sensitive in behaviour to group norms than were field independent people, and were shown to have a characteristic pattern of early experience in upbringing as well.

The terms "field dependence" and "field independence" were conceived as representing the extremes of a continuum that reflected a dimension of personality which corresponded roughly to activity-passivity in dealing with the environment.

In order to test their hypotheses Witkin et al compared measures based on these perceptual situations with measures of personality based on

several widely used clinical techniques, including inter alia, the assessment interview, Rorschach, TAT and the Draw a Person Test. They interpreted their results as indicating considerable validity to the general field dependence hypothesis. Witkin et al(1954.)

Searching deeper for sources of these basic differences Witkin et al explored to what extent institutional characteristics may have been responsible. They attempted to find out to what extent the differences were determined by the life experiences of the children, both in family and in society. Mother-child relationships were considered as an answer, based on the hypothesis that field-dependent children were likely to have been hampered in growth. The classification of mothers in terms of whether she was "growth fostering" or "growth-constricting" were found to be significantly related to the childrens' perceptual performance. Children with a field-dependent style of perceiving usually had mothers characterized as growth constricting - field independent children had mothers characterized as growth fostering.

Obviously, constitutional differences among children are also important and differences in early life experiences are not the overall causal factors.

Witkin may be criticized on some methodological shortcomings in his analysis and interpretation of the etiology or genesis of the respective poles of the field dependence - independence dimension.

Many of the reported relationships are suspect mainly because of a failure to deal effectively with the validity of the personality measures and interview scores that were utilized in his researches.

Although some doubt may be cast upon Witkin's findings in the above

respects, the possible findings of connections among areas of psychological functioning formerly considered quite unrelated, suggests that circumscribed perceptual processes need to be studied in relation to the individual's general psychological characteristics.

Stage V The Extension and Elaboration of this Work into the Construct of Psychological Differentiation

Witkin designated the analytic style of functioning of the field independent in relation to many diverse types of problems as an analytical field approach. The field dependent person, on the other hand, was termed as having a global approach. Witkin et al (1962)

The experiments which support this claim range from what may be seen as more restricted perceptual problems, to those having a demonstrable bearing on the individual's broader functioning. This broader functioning Witkin related to the concept of psychological differentiation:

" . . . experience of the body-field matrix is early essentially global, and during development becomes progressively more articulated so that body, self, and objects in general are experienced as segregated. Segregation or analysis, and with it structuring of experience - of what is outside and of what is inside - are manifestations of developed psychological differentiation. The growth of a segregated, structured self - or self-differentiation - is in this view part of the process of articulation of experience".

(Witkin et al 1962).

The final construct "Psychological Differentiation", proposes that individuals are likely to function at a more differentiated or less differentiated level in many areas of behaviour.

CHAPTER II

FIELD DEPENDENCE AND ABNORMAL SENSORY ENVIRONMENTS

In recent years there has been an increasing interest in investigating the behavioural effects of confining human subjects under conditions of reduced sensory input - "sensory restriction". Schultz (1965).

Varying periods of exposure to reduced and unchanging sensory input have produced physiological and psychological changes. The occurrence of effective change and impairment in the cognitive, perceptual and learning areas of psychological functioning have been clearly demonstrated. Inter alia Bexton, Heron and Scott (1954); Leiderman, Mendelson, Wexler and Solomon (1958); Solomon et al (1961); Cohen, Silverman and Shmavonian (1962); Jacobson (1966).

Of principal relevance to the present study, however, are those researches which relate findings of the effects of sensory restriction to the field dependence - independence dimension.

These findings are set out according to:

- (1) Differences in the Reaction to Sensory Deprivation
Among Field Dependent and Field Independent Subjects.
- (2) The Effect of Sensory Restriction on a Test of Perceptual
Field Dependence.

1. Differences in the Reaction to Sensory Deprivation Among Field Dependent and Field Independent Subjects

Cohen et al (1961) postulated that subjects who rely more on external rather than internal cues would react differently to an experience

in which external cues were lacking. A sample of 109 College subjects was tested on the Rod and Frame, and Draw a Person test to determine the extent of Field Dependency. Five body and six field subjects were selected and placed in a low sensory environment for two hours.

Field dependent subjects performed more poorly on pre- and post-experimental two point discrimination and letter identification, remained more aroused (GSR, EEG) and tended to move around more. Post-experimentally, they expressed more discomfort about the experiment, struggled more with feelings and fantasies (or denied them), were more suspicious and projected internal concepts more.

Other trends noted were a general decrease in arousal (GSR, EEG, pulse rate) for all subjects over the two hours and a direct correlation between:

- (1) amount of movement and verbalization artifact;
 - (2) GSR and discomfort;
 - (3) ego organization and sensory discrimination;
- and
- (4) adrenaline level and pulse rate.

Cohen et al (1962) in a similar experiment found that field dependent subjects, in contrast to field independent ones showed:

- (1) most intense psychological discomfort,
- (2) higher incidence of visual and auditory imagery,
- (3) more evidence of disorganization of thought,
- (4) greater discomfort with body sensations

- (5) less of an ability to discriminate somato-sensory cues which was most pronounced after the two hour experiment
- and (6) EEG and skin resistance evidence of a higher level of alerting during the experiment, although both groups started at the same level of activity.

2. The Effect of Sensory Restriction on a Test of Perceptual Field Dependence

Certain conditions have been known to increase field dependence like brain damage (Bailey, Hustmyer and Kristofferson (1959), or experimentally instigated distractions, Gross (1959).

Few investigators, however, have shown the corollary of this; the reduction of field dependence experimentally.

Gruen (1955) studied the effect of training in space orientation of a general nature, such as one receives in ballet or dancing, and found no significant differences in field dependence between experimental and normal groups.

Elliott and McMichael (1963) investigated the effect of specific training on the rod and frame test and found no durable and significant reduction in field dependence as a result of such training.

Where candidates have been subjected to sensory restriction lasting one hour, however, a significant reduction in field dependence as measured by the rod and frame test has been demonstrated.

Kubie (1961) and Robertson (1961) reported that under conditions of sensory deprivation (restriction) only the proprioceptive and enteroceptive components of sensory experience remain unobstructed. Zuckerman,

Albright, Marks and Miller (1962) pointed out that because of the absence of competition between external and internal stimuli for the field of attention, internal stimuli may seem more intense during sensory deprivation.

Among the more frequently reported effects of experimental sensory deprivation is increased attention to internal stimulation and concomitant changes in the subject's bodily sensations. Bexton, Heron and Scott (1954); Freedman, Grunebaum and Greenblatt (1961); Smith, Thakuros and Lawes (1961), all refer to verbal reports of changes in body awareness; "feelings of otherness", "arms and legs floating" and a variety of psychosomatic complaints.

Jacobson (1966), reasoned from the above findings that focusing of attention on bodily sensations may be reflected in perceptual tests that depend on awareness of enteroceptive and proprioceptive cues for accurate performance. He pointed out that the rod and frame test requires a resolution of the conflict between internal bodily cues and external perceptual cues in the determination of the vertical and hypothesized that, if sensory deprivation did serve to alter body awareness by focusing an proprioceptive and enteroceptive stimuli, then one could expect "a reduction in reliance on visual cues and a concomitant reduction in the level of perceptual field dependence". This would be manifested in a decrease in errors of orientation which would be measurable on the rod and frame test.

The RFT was administered to forty-one male and female college students of whom one half underwent one hour of sensory deprivation while the other half merely had their activity controlled. The post-test error reduction difference between the two groups was significant at $p < .05$. Jacobson explained the results on the basis of increases in awareness of bodily sensations and their consequent availability for use in orientation tasks.

CHAPTER IIICROSS CULTURAL STUDIES IN THE FIELD-
DEPENDENCE -INDEPENDENCE DIMENSION

The studies conducted by Witkin et al (1954) were concentrated within a single White cultural group.

One of the first cross-cultural studies involving space orientation was reported in the work of Beveridge (1939) even before Witkin had embarked upon his researches.

Using a tilting cupboard in which the subjects were placed and required to adjust a rod to the true horizontal, Beveridge concluded that Ghanaian students had skills "elaborated relatively more in a proprioceptive than in a visual realm when compared with Europeans", who tended to be more affected by visual clues. Beveridge reported, as Witkin did later, large individual differences in performance.

Dawson (1963) was the first to apply field independence theory to findings in Africa. He noted that socialization practices in certain African tribal societies resembled the situation producing the classical extreme of Witkin's field-dependent type. People were taught to respond to social standards, to be tradition directed rather than individualistic.

Tests of the kind used by Witkin produced field dependent performances from members of the Temne tribal group. Dawson (1963) concluded that these findings indicated a lack of habit of analysis for some types of visual material. This explanation received no support, however, from the observations of Preston (1964) and the experiment of Berry (1965), who showed that Eskimos as unlettered as Temne and with little contact with Western cultures, did much

better on tests such as Block Designs than did Temne. The orthodox explanations of Witkin and Dawson in terms of Temne socialization practices and the resultant levels of psychological differentiation were left in a strengthened position.

Wober (1966) working in Nigeria and following on from the work of Beveridge, Dawson and others, investigated two types of phenomena observed in West African culture; (1) that the performance at visually specialized tasks is often poor as found by McFie (1961), Dawson (1963) and Berry (1965) and (2) that some African cultures contain emphasis on sensory phenomena apart from the visual world.

Wober points out that among the African peoples studied, babies are strapped early in life to their mothers' backs and spend much of their time in an upright position. In addition, they learn to walk and dance extremely early and dancing and physical expressiveness remain extremely important elements in the physical activity of the culture. Many West African languages are tonal, and rhythm and tone direction are subjects of elaborate attention. Hence this non-visual field of perception would tend to be relatively well developed. Such activities, though not necessarily proprioceptive, yet not visual, would argue for "directions of psychological elaboration apart from the visual world". Wober (1966).

Wober presented evidence to show that Nigerian subjects tested did not react to a range of tests with the same pattern as that shown by Witkin's American subjects. He concluded that this, together with the cultural evidence, suggests that men in the Southern Nigerian cultures studied represent a "sensotype" different from "sensotypes" in Western cultures. Wober defined the term "sensotype" as being "the pattern of relative importance of the different senses by which a child learns to perceive the world and in which pattern he develops his abilities". These patterns may be predominantly

visual in one culture while in another culture either auditory or proprioceptive or both senses may have a much higher relative importance.

Wober (1967) argued that Witkin's rod and frame test contains a proprioceptive component which makes it essentially different from tests involving purely visually mediated transactions. Hence, populations who might by culture or early training be especially sensitive to the proprioceptive field would show characteristically different patterns of scoring on this test. Wober's (1967) study supports this hypothesis.

Using a visual (embedded figures test), and a mixed visual proprioceptive test (the rod and frame test) Wober showed that a different pattern of response was elicited from African as compared to American subjects. Specifically the results supported Wober's own earlier studies showing that in certain West African cultures proprioceptively is relatively more elaborated with respect to visuality than is the case in Western cultures. West African subjects were shown to have scored better on tests where proprioceptivity was important, (a) relative to their scores on tests dependent on visuality and (b) relative to scores of Westerners on similar tests. Wober concluded from these results that the sameness of cognitive style through all fields of an individual's behaviour may not occur for Africans as it had been shown to for Americans.

CHAPTER IVRESEARCH DESIGN AND EXPERIMENTAL PROCEDURE4.1 Aim and Hypotheses

The principal aim of this study was to assess, on a test of field dependence, the Rod and Frame Test, the effects of experimental sensory restriction in a Bantu sample.

More rigorously this means testing the following research and statistical hypotheses:

H_r That $1\frac{1}{2}$ hours of sensory deprivation will lead to a significant reduction in the score obtained on the RFT.

H_o Brief sensory deprivation, lasting $1\frac{1}{2}$ hours does not bring about any significant reduction in the score obtained on the RFT.

4.2 Research Design

A 2 x 2 Latin Square Design involving 15 replications of two treatments to which subjects were randomly assigned.

Starting on the first day, and on each consecutive day of testing which followed, each of two subjects were randomly assigned to one of two treatments in the morning, and the second treatment in the afternoon. Two and a half hours of intervening neutral activity, over the mid-day period, were allowed to counteract any possible carry-over effects from treatment to treatment.

The Latin Squares scheduled below illustrate the form taken by the first 5 replications of the design.

Subject	TREATMENTS	
	Morning	Afternoon
1.	A	B
2.	B	A
3.	A	B
4.	B	A
5.	A	B
6.	B	A
7.	A	B
8.	B	A
9.	A	B
10.	B	A

Five Replications of the 2 x 2 Latin Square.

In the case of the 2 x 2 square there are only two possible orders, AB and BA, and it does not make any difference whether we replicate the same square or a series of independently randomized squares. Regardless of which procedure is used, each order will occur an equal number of times. In the design for this experiment it was decided to replicate the same square and randomly assign subjects to the squares.

4.2.1 Treatments

Treatment A = 1½ hours of sensory restriction

Treatment B = 1½ hours of controlled activity

Sensory restriction involved placing the subject in a sedent position in a completely darkened room for 1½ hours. Subjects received "white noise" from a white noise generator through a set of headphones at a level just sufficient to mask any possible external auditory sensation. Subjects were not allowed to move out of the room and were advised that the experimenters were in the adjacent room. Should they want to be let out they merely had to knock on the wall.

Controlled Activity

This involved the performance of three simple non-fatiguing tasks:

1. the two-hand co-ordination test
2. the Müller-Lyer Illusion test
3. the Draw a Man test

4.2.2 THE SAMPLE

The sample chosen consisted of 30 Xhosa mineworkers randomly chosen from a population with the following characteristics:

Age group	:	18 - 24
Education	:	0 - 4 years
Mining Experience	:	0 - 3 years

The reasons for choosing the sample with the above characteristics were as follows:

- (a) The previous findings of Beveridge (1939) and Wober (1967) which demonstrated cultural differences in performance on tests of field dependence.
- (b) The previous findings of Witkin et al (1954) in terms of age differences.
- (c) The possible influence of differential acculturative processes such as schooling and industrial experience on the field - dependence - independence dimension which had to be regarded as a contingency in the sampling procedure.
- (d) The composition of the intake at the Aptitude Test Centre (East Rand) was such during the time of testing that this group formed the largest proportion of the intake population.

4.3 Experimental Procedure

RFT.

Prior to any treatments subjects were inducted on the RFT, settings for which are detailed in Appendix B. Subjects were required to define their task in their own words before each RFT to ensure that they still remembered what they had to do. If they had forgotten, or were unsure, they were again given brief instructions.

Treatments

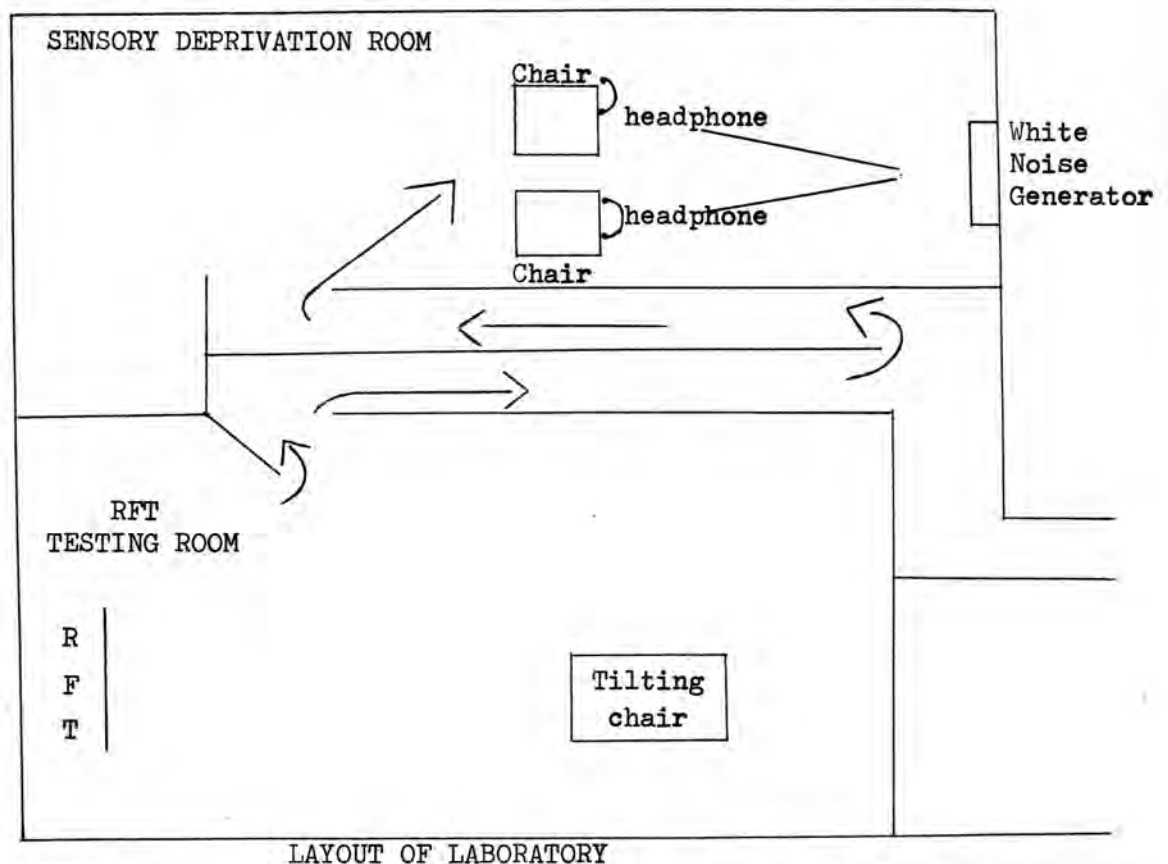
Subject 1 underwent treatment A in the morning on day 1, had a RFT immediately afterwards and 2½ hours later underwent treatment B followed by a second RFT.

Subject 2 underwent treatment B in the morning on day 1, had a RFT immediately afterwards and 2½ hours later underwent treatment A followed by a second RFT.

This procedure was repeated according to the assignment of treatments detailed in the full design shown in Appendix E.

Subjects were led directly from the sensory deprivation room to the RFT room next door via a light proof passage and hence were not subjected to any additional stimulation between the time of the end of treatment A and the RFT. Since subjects who had just undergone treatment A were already dark adapted they were not given 5 minutes of dark adaptation which was given to subjects doing the RFT after treatment B.

The layout of the laboratory is illustrated below.



Photographs of subjects undergoing treatments A and B appear on Pages 31 and 32.

Scoring Procedure

The scoring procedure adopted for the Rod and Frame Test was similar to that of Witkin et al (1954) in that the angular deviation of the rod from the true vertical for each trial was taken as a measure of performance. Whereas Witkin's readings were accurate to the nearest 1° , however, readings in the present study were all made to the nearest 0.5° .

For purposes of this experiment the sum of the four trials, in each of the three series respectively, was taken as a measure of performance.

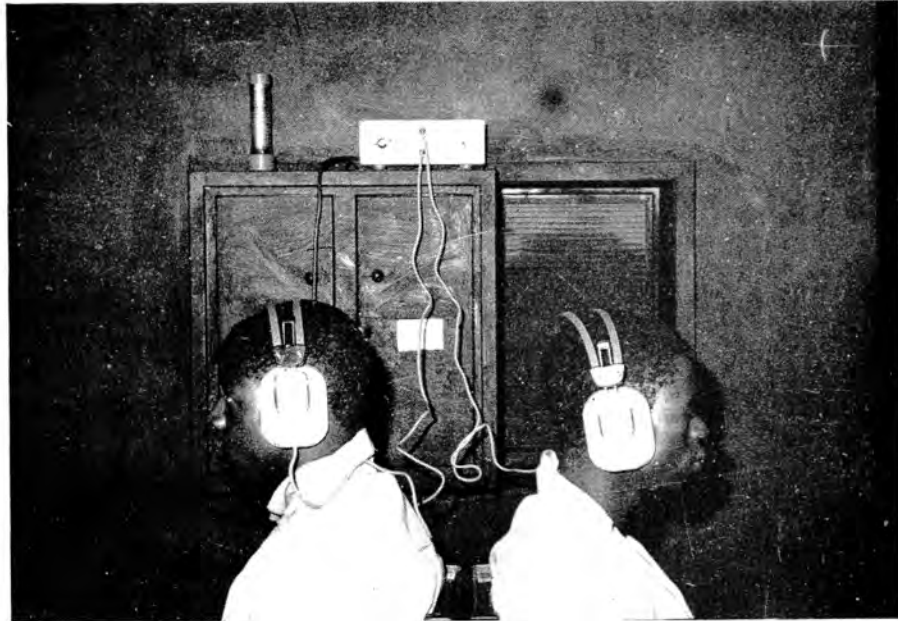


ILLUSTRATION I
Subjects undergoing treatment A

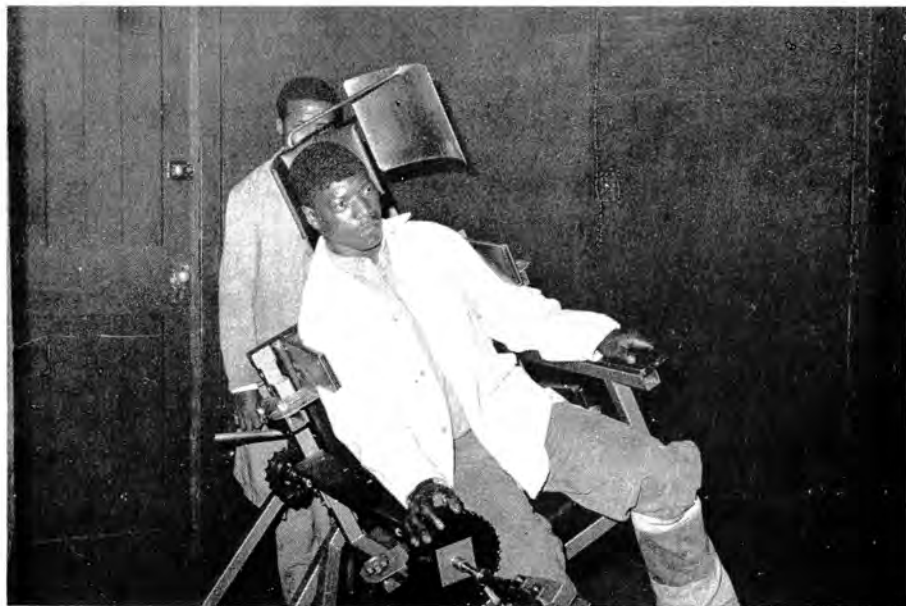


ILLUSTRATION II
Subject performing the rod and frame test.
(The mask referred to on p34 appears on
the left hand side of the subject's head)



ILLUSTRATION III
Subject undergoing treatment B
(The Müller-Lyer Illusion)

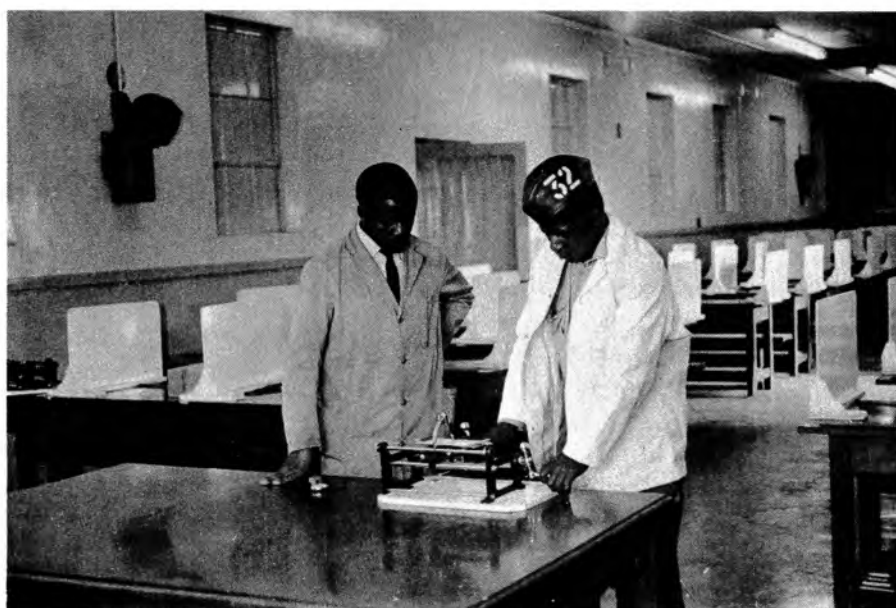


ILLUSTRATION IV
Subject undergoing treatment B
(The two hand co-ordination test)

CHAPTER V

THE ADAPTATION OF TEST MATERIALS AND INSTRUCTIONS TO THE BANTU SAMPLE

As a result of a preliminary testing programme which involved administering Witkin's rod and frame test to a heterogeneous sample of Bantu Mineworkers certain modifications necessary for simplification and standardization were incorporated into a newly designed rod and frame test and tilting chair.

Modifications were carried out on the RFT itself and a new set of test instructions appropriate for the sample was devised.

5.1 Modifications and Innovations to Test Materials

The Rod and Frame

5.1.1 The task of orientating the rod to true gravitational vertical was made entirely subject controllable by means of an hydraulic servo mechanism illustrated in Appendix F. In contrast to an electrical control system (selsyn) used by some researchers, the hydraulic servo mechanism constructed possesses operational verisimilitude. This is an important factor in the testing of unacculturated samples. The subject did not have to push a button in order to effect movement of the rod but rotated a wheel which moved the rod in the corresponding direction. (See photographs at end of Chapter V)

The main reasons for making the task subject controllable are :-

- (a) This procedure eliminates the difficulty of having the subject orientate the rod by means of verbal communication through an experimenter. Instead of having to rely on the

experimenter, the adjustment now becomes a direct physical function of the amount of movement of the wheel by the subject. The subject does not feel obliged to reach a decision too quickly in order to "satisfy" the experimenter and can effect the adjustments in his own time.

- (b) Verbal communication during the task is now cut down to a minimum. This is a highly desirable requisite in the rod and frame test situation which has been ignored by previous workers in this field. Talking can lead to auditory localization cues which can be employed by the subject in effecting his adjustment of the rod.

5.1.2 Adjustments of the rod were now made possible along a continuum ranging from 105° left to 105° right of true gravitational vertical instead of in discrete steps of 3° each. Readings on a 14" protractor were possible to an accuracy greater than 0.5° . However, in practice readings were only taken to the nearest 0.5° . Such increased accuracy, it was hoped, would lead to greater discrimination between subjects.

5.1.3 The rod and frame apparatus was constructed in such a way that it could be raised or lowered in steps of $\frac{1}{2}$ " to accommodate to the line of vision of the individual subject. The central axis of the rod and frame were aligned for each individual subject, eliminating any effects of asymmetry which could possibly occur.

5.1.4 An adjustable mask which is illustrated in the photographs at the end of this chapter replaced the blindfold used by previous

workers in this field.

The movement of the mask was controlled only by the second experimenter who made adjustments to the tilt of the chair. Hence the movement of the rod and frame by the experimenter in setting up each trial remained invisible to the subject, who was presented with a completed trial setting once the mask was removed.

- 5.1.5 The rod and frame were coated with a new non radioactive (tritium) luminous paint which glowed with a blue-white hue for at least two hours without any perceptible reduction in intensity. Since the duration of the rod and frame test averages 25 minutes the paint employed was adequate from the point of view of stimulus invariability.

Except for the frame which was 40" square, instead of 42" square, the apparatus was similar in the remaining respects to that employed by Witkin.

The Tilting Chair

- 5.1.6 Adjustable shoulder pads, hip pads, head rest (as suggested by the N.I.P.R.) and foot rest were built into the chair to control the movement of the subject while being tilted (Illustrations at end of chapter V).
- 5.1.7 The axis of rotation of the chair was centred in such a way that it would correspond as nearly as possible to the centre of gravity of the "average" subject undergoing the test. This was done in order to maintain symmetry as far as possible in the vertical and horizontal planes during tilting of the subject.

5.1.8 The chair, which was constructed out of 1" square steel hollow tubing could be dismantled and was fully portable. Certain of these modifications and innovations are determined by the nature of the test sample. Others are improvements aimed at increasing experimental control by the addition of certain refinements in the original test apparatus.

5.2 The Development of a New Set of Test Instructions

With the illiterate and semi-literate samples on which all the testing was to be carried out, it was not possible because of semantic and conceptual difficulties to use the same test instructions as Witkin's. Due to the fact that the task had now been made subject controllable certain additional changes were found to be necessary in the test instructions.

One of the most important departures made from the procedure adopted by Witkin is that the subject was shown the apparatus before he was required to perform the task. This procedure was necessary because the subject had to be trained to understand the functions of the various parts e.g. wheel, stick in order to follow the test requirements. Furthermore, this method reduced any anxiety which might be evoked by leading subjects blindfolded into a completely unfamiliar situation. This procedure does not bias results in any way since the actual test itself was conducted in complete darkness and the important criterion was that the subject did not have any visible vertical or horizontal standards by which to make his judgement. Elliott and McMichael (1963) have shown in addition, that even specific training has no significant or durable effect on performance on the RFT. The procedure of showing the subject the

rod and frame beforehand, during task instruction, has also been adopted by the N.I.P.R. Care was taken, however, not to place the frame at the setting used during actual testing, since subjects could note mentally the correct position of the rod in relation to the frame and use this cue in effecting their first judgment.

At first great difficulty was experienced by some subjects with the concept of true vertical and various analogies were tried out - poles, the walls of the room, a plumb line and the vertical plank behind the frame. The final most effective standard instruction was the analogy of a man standing upright on the ground. Subjects, as can be seen from the test instructions, were told that even when the lights were switched off they had to orientate the rod to the position which a man is in when standing erect on the ground. All subjects were rigorously trained in the requirements of the test situation.

Since this analogous instruction procedure has been introduced a total of some 250 subjects have been tested and only 3.5% of this number have experienced difficulty in understanding what was required of them.

The test instructions and administration are presented in Appendix C.

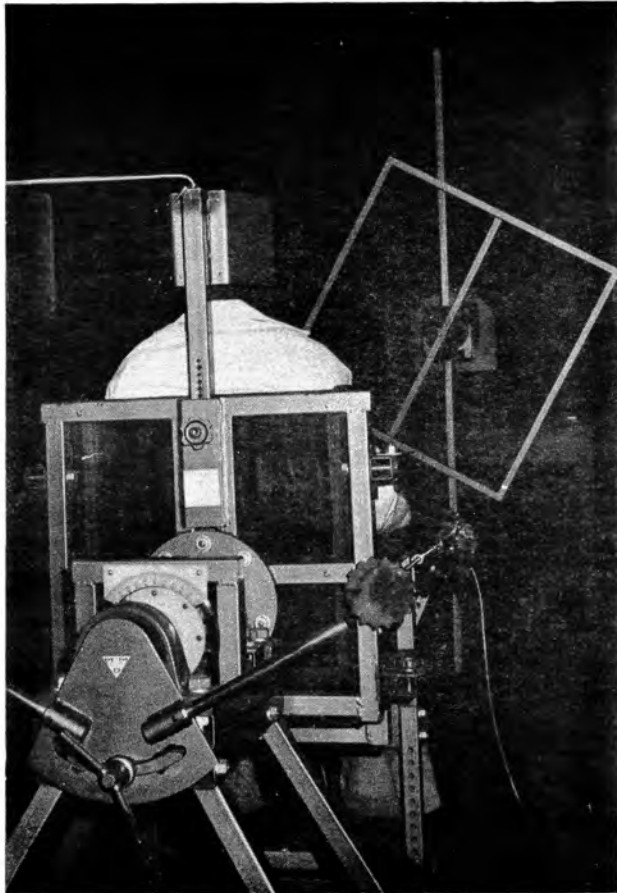


ILLUSTRATION V
Rear view of tilting chair
and rod and frame test

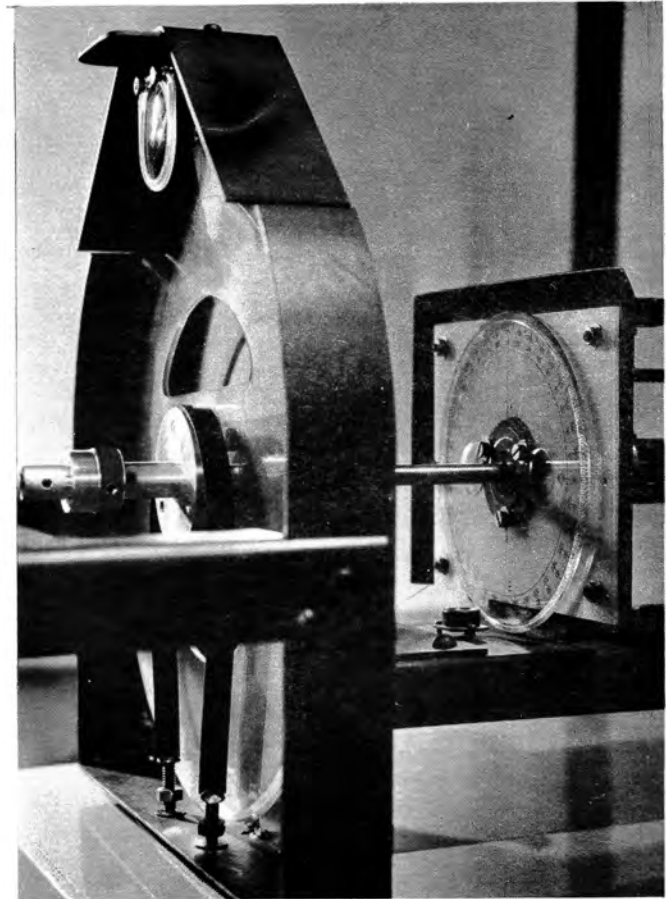


ILLUSTRATION VI
Rear view of rod and frame
illustrating protractors and
reading mechanism

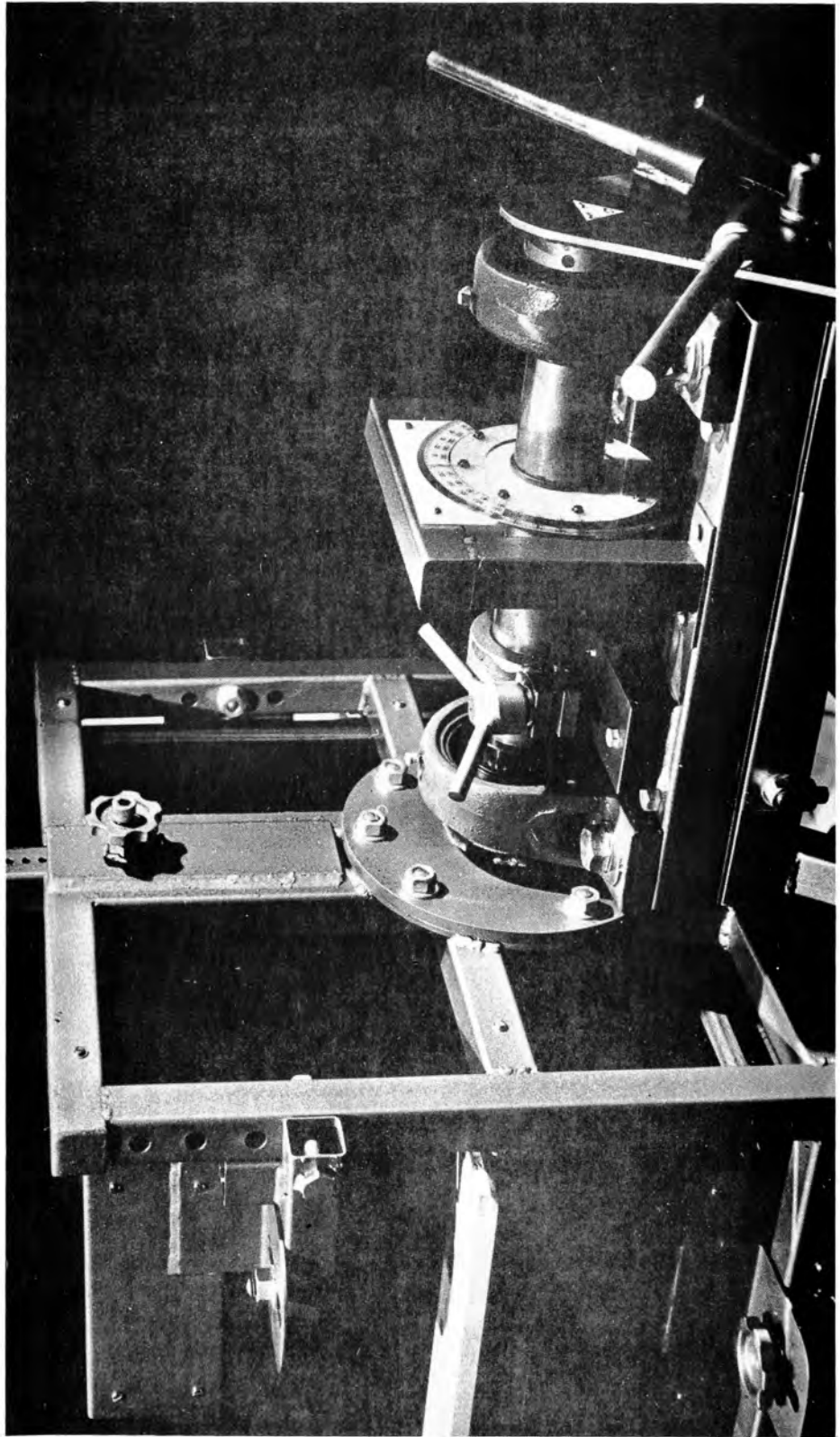


ILLUSTRATION VII
Rear view of mechanism of tilting chair

CHAPTER VITESTS FOR CONSTRUCTION ARTIFACTS AND RELIABILITY6.1 Artifacts6.1.1 The Need for Preliminary Basic Research

Before a perceptual situation is applied to the study of perception, it should be investigated carefully in order to establish the roles of all variables that influence performance in it. Unless the effects of these variables are known and controlled it is not possible to presume that differences among samples reflect differences in factors being investigated.

Such elaborate research is especially necessary since perceptual processes are typically quite "sensitive" in that they are readily affected by slight changes in the conditions under which they are produced. Often, especially in the field of cross cultural research, well known and long used perceptual techniques are simply taken over as they exist for use in studies of perception. Thus it is possible for slight modifications in the instructions used in defining the subjects task e.g. to lead to important changes in results which may in turn be interpreted as basic cultural or treatment differences.

It was principally for the above reasons that a pilot study was undertaken to establish, inter alia, the nature of quantitative and qualitative performance on the Rod and Frame Test among a selected group of Bantu

Mineworkers, before proceeding to evaluate the effects of specific chosen environments upon performance in this test situation. The pilot study was necessary, in addition, to test the effectiveness of the newly developed test instructions, procedure and modifications to test equipment.

6.1.2 Modes of Orientation in a Selected Sample of Bantu Mineworkers

The Sample:

A sample of 50 Xhosa mineworkers within the age category 18 - 24 (\bar{X} = Age 21); matched as far as possible in terms of education (0 - 6 yrs) and work experience (0 - 50 months) was chosen as a pilot study group from a larger, far more heterogenous group of testees in terms of culture, age, education, experience etc. The larger sample had undergone a battery of tests including the RFT as part of a far more extensive research project presently being undertaken and of which this dissertation describes a part. The reasons for choosing the sample with the above characteristics were identical to those stated on Page 28 for the Research Design. More rigid stratification was sacrificed in terms of requirements for a sample size which would be statistically adequate. Witkin et al (1954) had reported large individual differences in performance on this test. This necessitated the use of fairly large numbers in samples.

Modes of Orientation

When asked to adjust the rod to the upright most subjects displaced it in the direction of the tilt of the frame. However, as was found by Witkin with American

subjects, individuals differed markedly in the extent to which they were affected by the frame. Certain subjects were able to disregard the frame almost entirely in making their adjustments both with body erect and with body tilted and succeeded in bringing the rod to within a few degrees of true gravitational vertical. On the other hand, some subjects based their perception of the upright almost exclusively in relation to the frame. The majority orientated the rod to a position representing some degree of compromise between the vertical of the tilted field and the vertical indicated by the body.

Perceptual shifts, as reported by Witkin, were also recorded with subjects in this study. Whenever such shifts occurred that particular trial was repeated, unbeknown to the subject, and invariably the adjustment made the second time was close to the average values within that particular series.

6.1.3 Test Results

The means and standard deviations for the pilot study are presented in table I together with those obtained by Witkin.

The results show features of both agreement and disagreement with Witkin's findings and raise the question of a possible test artifact.

TABLE I : RESULTS OF PILOT STUDYN = 50; \bar{X} 's AND σ 's

Trial		Present Data N = 50		Witkin's Data N = 136	
		\bar{x}	σ	\bar{x}	σ
S E R I E S I	1	14.6	7.2		
	2	12.7	8.0		
	3	11.6	8.8		
	4	13.8	8.4		
\bar{x}		13.2	8.2	12.4	7.4
S E R I E S II	5	12.1	6.9		
	6	9.0	6.6		
	7	9.4	7.4		
	8	10.8	7.2		
\bar{x}		10.3	7.2	14.5	6.6
S E R I E S III	9	10.4	6.2		
	10	7.6	6.5		
	11	8.2	6.1		
	12	9.2	6.0		
\bar{x}		8.9	6.4	7.4	5.5

Agreement with Witkin's Results

- (a) Significant differences were found between the means of series ($F < .05$). (F test).
- (b) No significant differences were found between trials within a series (Analysis of Variance)

- (c) With respect to the size of means standard deviations are large. This indicates widespread individual variation.
- (d) Means for trials I and III for both the present study and for Witkin's sample are of the same order of magnitude.

Disagreement with Witkin's Results

Whereas Witkin's European sample scored significantly higher in Series II than in Series I, the Bantu sample scored higher in Series I.

In view of this difference, the hypothesis was put forward that the Bantu were performing better in Series II simply because they understood the task better at this stage of the test, and that some form of practice effect was operative in the first four trials of the test. This effect, it was hypothesized further, had levelled off by the time Series II was done.

In order to examine what appeared to be a possible artifact of test construction, an experiment was designed to test this practice effect.

A group of 30 Bantu mineworkers, heterogeneous in terms of culture, age and experience were randomly assigned to a RFT in which the order of series was II, I, III.

The rationale behind this design was that if the relative magnitude of mean scores obtained was a function of practice then Series II would then have a higher mean score than Series I.

The same relative mean magnitudes, however, remained with this reversal of order.

TABLE II

N = 30

Series	
II	12.5
I	18.2
III	10.5

Hence the hypothesis that this difference is due to an artifact of construction was rejected.

6.2 Test Retest Reliability

In terms of the Research Design which required that the RFT be administered twice to each subject within one day it was necessary to evaluate the consistency of the RFT on the samples being studied.

McMichael and Elliott (1963) have already shown that specific training on the RFT had no significant and durable effect on control and experimental samples. Witkin et al (1962) report test - retest correlations of 0.84 for the RFT.

However no figures were available for the specific samples with which this design was concerned and a test-retest reliability coefficient was accordingly determined.

The intervening time period between the tests was 4.5 hours. This true period was chosen since it represented the mean time interval between the two administrations of the Rod and Frame

Tests.

The Kendall Rank Coefficient yielded a correlation of 0.91 which is significant ($P < .01$).

This evidence strengthens the case that in the research design as carried out, differences in performances are veridical in terms of sensory deprivation and are free of practice effects.

In the research design it will be remembered, each subject has two treatments and two rod and frame tests. The order of treatments alters from subject to subject. Practice would therefore be likely to show up equally on either of the alternate treatment sets. We should therefore expect that if practice improves performance this would be true of the condition in which sensory restriction precedes controlled activity as well as that condition in which it follows.

CHAPTER VIISTATISTICAL TREATMENT OF DATAHETEROGENEITY OF VARIANCE AND TESTS FOR NORMALITYHeterogeneity of Variance

In the 2 x 2 Latin Square Design chosen, the number of observations for the various treatments is the same. Since it is proposed to conduct an analysis of variance on the data, and since under the above conditions the F test is insensitive to variance inequalities, (Box 1953) it is unnecessary to examine the data for heterogeneity of variance.

Tests for Normality

By examining the distribution of the residual mean squares for all observations in each of Series I, II and III, it was possible to obtain an estimate of the normality of the respective distributions. The cumulative proportion distribution of the residuals were plotted on normal probability paper (Appendix D).

The plot of points for Series I approximated a straight line. The plots for Series II and III showed irregularity but no marked curvilinearity. These irregularities are principally due to the fact that individual, and not grouped data, have been plotted.

By virtue of the nature of the Design of this Experiment, the obtained data is most amenable to treatment by an analysis of variance. This being the preferred treatment, an investigation was conducted into the consequences of treating the data in series II and III, with the aforementioned distribution properties.

The basic assumptions which underlie the analysis of variance

procedure are such as take account of both heterogeneity of variance and non normality of distribution.

"As Box (1953) has emphasized, since the F test is very insensitive to non normality and since, with equal n's it is also insensitive to variance inequalities, it would be best to accept the fact that it can be used safely under most conditions. The F test of the analysis of variance, in other words, remains a robust test under a variety of violations of the assumptions on which it is mathematically based" Edwards (1962).

Hence, the subjecting of the data to an analysis of variance, does not violate the basic statistical assumptions.

Analysis of Variance of the Latin Square Design

Fifteen replications were found to be adequate in the statistical analysis proposed and any additional replications would have been merely additive, without being essential.

These data are set out in Tables I, II and III which summarize the Analysis of Variance for 15 replications of the 2 x 2 Latin Square for Series I, II and III respectively. Raw Data appear in Appendix E.

The data for each of the three series have been treated independently since it has been shown, both in Witkin's work, and in the pilot study of this experiment, that significant differences exist between the series.

TABLE IANALYSIS OF VARIANCE FOR 15 REPLICATIONS
(SERIES I) OF THE 2 X 2 LATIN SQUARE

<u>Source of Variation</u>	<u>ss</u>	<u>d.f.</u>	<u>m.s.</u>	<u>F</u>
Treatments	1638	1	1638	7.12
Rows	13470	29	464	
Columns	63	1	63	
Error	6443	28	230	
Total	21614	59		

F Ratio Significant $P < .025$ TABLE IIANALYSIS OF VARIANCE FOR 15 REPLICATIONS
(SERIES II) OF THE 2 X 2 LATIN SQUARE

<u>Source of Variation</u>	<u>ss</u>	<u>d.f.</u>	<u>m.s.</u>	<u>F</u>
Treatments	580	1	580	7.84
Rows	10824	29	373	
Columns	70	1	70	
Error	2089	28	74	
Total	13563	59		

F Ratio Significant $P < .025$ TABLE IIIANALYSIS OF VARIANCE FOR 15 REPLICATIONS
(SERIES III) OF THE 2 X 2 LATIN SQUARE

<u>Source of Variation</u>	<u>ss</u>	<u>d.f.</u>	<u>m.s.</u>	<u>F</u>
Treatments	525	1	525	48.61
Rows	12380	29	427	
Columns	1	1	1	
Error	303	28	10.8	
Total	13209	59		

F Ratio Significant $P < .001$

The magnitude of the F ratios ratifies the decision to use the analysis of variance with the samples concerned. It is clear that the ratios obtained are sufficiently large to nullify the possibility of biasing of effects due to non normality of the distribution and to support the view that the differences are veridical.

The relatively large F ratio obtained for data in Series III may be attributed principally to the large variance contributed by the "Rows source of variation". This means that there was a relatively larger variance among subjects in response to the treatment in Series III than in the previous two Series. The effect of this has been to reduce the magnitude of the experimental error variance and consequently to yield a larger F ratio.

CHAPTER VIIISIGNIFICANCE OF THE FINDINGS

The results of this study as set out in the last chapter have both theoretical and practical significance. They determine the tenability of the hypothesis set up. They corroborate the research work of earlier researchers. They make a significant contribution to cross cultural studies and they mark the termination of the first stage of a research investigation in the applied field.

The Null Hypothesis, H_0 , originally established, was that brief sensory restriction lasting $1\frac{1}{2}$ hours would not bring about any significant reduction in the score obtained on the Rod and Frame Test. This hypothesis can now be rejected.

The alternate Research Hypothesis, H_r , that brief sensory restriction will lead to a significant reduction in the score obtained on the RFT can be accepted.

This means that with a specific Bantu sample after a brief exposure to a sub normal environment, sensory restriction can be induced and its effects successfully measured on the Rod and Frame Test.

These findings support those of Jacobson (1966) on a Western White cultural group. He obtained a statistically significant post-test error reduction between his experimental (sensory deprived) and control groups. Jacobson's findings have therefore been confirmed on a very different sample from those which he himself used. This corroboration gives to his findings the added support which comes naturally from cross-cultural investigation. Jacobson advanced an argument to account for this phenomenon.

At this point it is worth while recalling the finding that practice effects on the Rod and Frame Test are negligible and certainly not significant. The nature of the design of the experiment, in addition, eliminates possible biasing of results due to the effect of practice. The improvement in performance under discussion here is primarily an improvement due to the treatment variable i.e. to the intervening sensory restriction variable.

It has been argued, that an individual's response to the Rod and Frame Test represents a combination or interaction of internal proprioceptive stimuli and external visual stimuli. What is characteristic of this interaction is reciprocal selectivity. This means that the effectiveness of the response depends upon the relative contributions made by the two different populations of stimuli. Under normal rod and frame testing conditions a subject's response is some derivative from both types of stimuli. Whenever one or other of the types of stimuli involved are materially diminished, experimentally or otherwise, it seems reasonable to argue that the interaction response will be characterized by different derivative amounts, depending on which of the typical stimuli are diminished. It follows therefore, that when external visual stimuli are experimentally extinguished or diminished, internal stimuli would play a major role in the judgement of verticality in the Rod and Frame Test situation. We should expect a reduced reliance on visual perceptual cues and an increased dependence upon proprioceptive cues - a reduction of "field" derivative stimuli and an increase of "body" stimuli. In other words, we should expect scores on the Rod and Frame Test to improve in the direction of field independence.

Witkin et al (1954) have conclusively shown that the principal determinants operative in orientation to the vertical are visual and postural, and that the resulting judgements represent an integration between these two sense modalities. A reduced score on the Rod and Frame Test should therefore indicate a reduction of the influence of one of these two sense modalities. It follows logically that there should be a reduction in reliance on the visual field. It can therefore be argued following Witkin and Jacobson that the performance of the Bantu sample in the present investigation conforms to expectation. The reduction in size of test scores in the experimental treatment is in the expected direction and the shift after brief sensory deprivation towards field independence is a classical finding in terms of the theoretical framework.

The cross cultural implications of the study and of the findings deserve some mention at this point.

The present study is the first time, to the authors knowledge, that tests of field-dependence-independence have been used to measure the effects of sensory restriction in an unacculturated sample. In order to achieve this it has been necessary, as has been pointed out, to modify both test construction and test instructions in order to meet the experimental objective. What is of importance is that the experimental objective has been achieved, and it is important to make the point here that it is possible to measure the effects of sensory restriction on the Rod and Frame Test in an unacculturated sample and to determine that these are statistically significantly altered as a result of exposure to such an environment.

Test materials and test situations which have been used as a basis for theoretical frameworks on Western cultural samples have proved,

with modifications, to be equally valid and useful on unacculturated samples.

The test procedures developed in this study applicable at all educational levels within these samples from complete illiteracy upwards.

Artifactual problems, such as might be expected to arise semantically, or as a result of construction of the apparatus have been solved and it has been shown that performance differentials are true and not artifactual ones.

Apart from theoretical considerations this study has a practical usefulness. It is the first step in a much larger research programme designed ultimately to explore the effectiveness of the field dependence-independence concept as a basis for the establishment of a selection process, designed to minimize exposure to accident provoking situations in abnormal underground environments.

It has been established experimentally, that a Bantu sample which is not atypical of industrial workers in a mining environment in South Africa, is open to short term sensory restriction. These effects occur in the expected manner and can be measured by means of the Rod and Frame Test.

As it stands, this study is essentially a laboratory experiment. It is necessary therefore to extend it from the laboratory into the real operational situation and to determine in that situation, not only the short term effects, but also the long term and possible cumulative effects of abnormal sensory environments on Bantu Industrial workers.

While this is the principal objective, there are two important

side issues which require investigation. On the one hand, it is necessary to establish the relationship of performance on the Rod and Frame Test with performance on other perceptual and psychomotor tests for the unacculturated samples. On the other hand, it is necessary to investigate the effects of such factors as ethnic grouping, age, educational level and operational experience upon tests of field-dependence-independence in order to be able to isolate the effect of such factors from the sensory restriction effect.

The present laboratory study and its findings are basic and germinal to all these applied investigations.

This study has value therefore, not only in the field of applied psychology such as the possibility of contributing to the reduction of accidents but represents a contribution to the work of Witkin, Wober, Dawson, Bexton Heron and Scott, Cohen Silverman and Shmavonian.

The works of the above researchers represent, inter alia, investigations into the nature of man's dependence on the external sources of environmental stimulation for the maintenance of integrated functioning in the perceptual, psychomotor and cognitive fields of human operations.

APPENDICES

APPENDIX ADESCRIPTIONS OF THE VARIOUS ORIENTATION
TESTS EMPLOYED BY WITKIN ET AL1. The Rod and Frame TestDescription

The apparatus used consisted firstly of a luminous square frame, (42" x 42" x 1") within which, in the same plane, was a luminous rod (1" wide x 39" long) pivoted to a common centre, but moving independently. Two protractors, one mounted on the frame shaft and the other on the shaft of the rod, each moved against a stationary pointer and permitted direct readings of the frame and rod respectively.

Secondly, a wooden "tilting chair", was placed seven feet in front of the rod and frame apparatus. It had a high back support, an adjustable headrest and a footrest. This chair could be placed in any one of three positions; tilted 28° left, upright, or tilted 28° right.

Administration

The test was conducted in a completely darkened room, the subject being able to see only the rod and the frame. Sitting erect or tilted, the subject was presented with the luminous rod and frame in tilted positions and was required to adjust the rod to the true upright while the frame remained tilted. The subject was blindfolded during settings made by the experimenters for respective trials.

Conditions of the test

Three series, each consisting of eight trials comprised the standard test:

- (a) Series I : The subject was tilted to one side (at 28° left or 28° right) and the frame was tilted to the same side (at 28° left or 28° right). The rod had to be adjusted to the upright from an initial tilt of 28° (at times to the same side as the frame, at other times to the opposite side).
- (b) Series II : Body and frame were tilted to opposite sides (both at 28°)
- (c) Series III : The body was erect and the frame tilted to left or right (at 28°).

Scoring

Witkin described the score for each of the three series of the test as the mean absolute error in degrees from the true vertical for the respective number of trials, i.e. 8 of the series. The raw scores for each series were converted into standard scores using the mean and standard deviation of the sex-age group to which the subject belonged. The total RFT "index", sometimes referred to as the "perceptual index" was the mean of the standard scores for the three series, equally weighted.

2. The Tilting-Room-Tilting-Chair Tests (TRTC)

Description

For both the BAT and the RAT the same piece of apparatus was used. This consisted of a small boxlike room (70" high x 71" wide x 69" deep) within which was a chair projecting into the room open at its rear end.

Since the room and chair had separate driving mechanisms, it was possible to tilt the room alone, the chair alone or both together, either to the same or opposite sides. The angular positions of both the room and chair could be determined by the experimenter from the control panel situated behind the chair.

Administration

The subject, seated in the chair could not see outside the experimental room. The test procedure consisted of tilting the room and the chair to set positions and then requiring the subject to adjust one or the other to the upright - the room on some trials (RAT) and the chair on others (BAT).

Conditions

The standard test consisted of three parts; eight room-adjustment trials (Part 1), six chair-adjustment trials with eyes open (Part 2), and eight chair-adjustment trials with eyes closed (Part 3).

Part 1 (Series 1a and 1b). In each of the eight trials here the chair was tilted 22° and the room 56° , the direction of tilt of each varying from trial to trial. In each trial the subject attempted to orientate the room to vertical while his chair remained at its initial angle of tilt (RAT). In series 1a, consisting of four trials, the room and chair were initially tilted to the same side. In series 1b also four trials, room and chair were tilted to opposite sides.

Part 2 (Series 2a and 2b). In the six trials here the room was initially tilted at 35° and the chair at 22° . The subject was required to orientate his body (BAT) while the room remained in its

initial position. In series 2a, comprising the first three trials, room and chair were initially tilted to the same side. In the last three trials, series 2b, they were tilted to opposite sides.

Part 3 (Control Series 2a). The subject was required to orientate his body while his eyes were closed, given eight trials, four in which the initial tilt of the chair was 22° left, and four in which it was 22° right.

Scoring

The scoring procedure adopted in this test was similar to that adopted in the RFT, the score in each trial being the number of degrees the subject's body was from the true vertical when he reported it upright.

Description

The apparatus employed consisted of a small fully enclosed room, mounted on a carriage which was driven about a circular track. Both the room and chair could be tilted as in the tilting-room-tilting-chair tests. The rotation of the whole unit and the tilting of room and chair were controlled from the outer laboratory by the experimenter.

Conditions

The standard test consisted of two parts, in each of which four trials were presented:

- (a) Series 1 : Room and chair remained in their initial objectively upright positions and the subjects' task was to orientate the room to true vertical if it appeared tilted to him.
- (b) Series 2 : The room and chair were again positioned in their initial objectively upright positions and here the subjects'

task was to orientate his chair to the upright if he perceived himself as tilted.

Scoring

The positions in which room and chair were perceived as upright by the subject could be measured to the nearest degree and the results expressed quantitatively as in the RFT, BAT and RAT.

APPENDIX B.SETTINGS OF FRAME, ROD AND CHAIR FOR PRACTICE AND TEST TRIALS

	TRIAL	FRAME	ROD	CHAIR
P R A C T I C E	01	Clockwise	Clockwise	Clockwise
	02	Clockwise	Clockwise	Anticlockwise
	03	Anticlockwise	Clockwise	Clockwise
	04	Clockwise	Anticlockwise	Anticlockwise
S E R I E S I	1	Anticlockwise	Clockwise	Clockwise
	2	Clockwise	Clockwise	Anticlockwise
	3	Anticlockwise	Anticlockwise	Clockwise
	4	Clockwise	Anticlockwise	Anticlockwise
S E R I E S II	5	Clockwise	Anticlockwise	Clockwise
	6	Anticlockwise	Anticlockwise	Anticlockwise
	7	Clockwise	Clockwise	Clockwise
	8	Anticlockwise	Clockwise	Anticlockwise
S E R I E S III	9	Anticlockwise	Clockwise	Vertical
	10	Clockwise	Clockwise	Vertical
	11	Anticlockwise	Anticlockwise	Vertical
	12	Clockwise	Anticlockwise	Vertical

Settings made above for the chair and rod were clockwise or anticlockwise when facing the frame from the chair whereas settings for the frame were clockwise or anticlockwise when facing the chair, viewed from the frame. All angular settings for chair, frame and rod were 28° .

APPENDIX CROD AND FRAME TEST INSTRUCTIONS
WITH TYPICAL RESPONSES BY SUBJECTSI. Subject must identify true vertical (upright timber
behind the RFT)

- Tester : "Yini lo yinto lo?"
"What is this?"
- Subject : "Yena lo plank"
"It is a plank"
- Tester : "Nyanis! Manje buka yena : yena streyit,
"Fanakalo madoda lo yena mile, hayikona?"
"Correct! Now look at it : it is straight (i.e.
upright/vertical) like a man standing erect;
not so?"
- Subject : "Ja, yena streyit fanakalo madoda lo yena mile."
"Yes, it is erect like a man standing".

II. The stick (rod)

- Tester : "Manje nangu lo munye mpahla lo tina jobisa : yena
lo stik; - yini lo?"
"Now here is another piece of equipment we use :
it is the rod (stick); - what is it?"
- Subject : "Yena lo stik"
"It is the rod (stick)

III The stick moves

- Tester : "Ja, yena lo stik. Lo stik yena hamba fanakalo
(tester rotates rod to vertical position,
aligning it with the vertical plank). Tshela

mina skat yena streyit fanakalo plank, fanakalo madoda lo yena mile".

"Yes, it is the stick. The stick moves like this (tester rotates rod to vertical position, aligning it with the vertical plank). Tell me when it is erect like the plank and like a man standing erect."

IV. Stick and plank is same vertical line as a man standing erect

Subject : "Ja, ... (subject watches the rotation and indicates when rod and plank lie in the same straight line) ... STOP. Yena streyit".

"Yes, ... (subject watches the rotation and indicates when rod and plank lie in the same straight line) ... STOP. It is straight".

Tester : "Ja, yena streyit fanakalo plank; fanakalo lo madoda lo yena mile futi. Zonke skat tina funa yena streyit fanakalo madoda lo yena mile. Izwa?".

"Yes, it is straight like the plank, and like a man standing erect. Always we want it straight as a man standing erect. Understand?"

Subject : "Ja".

"Yes".

V. Only the stick is movable by the subject

Tester : "Lo stik yena hamba, lo plank yena hayikona hamba; yena streyit zonke skat, streyit

fanakalo madoda lo yena mile. Wena izwa?"

"The stick moves (rotates). The plank never moves; it is always straight like a man standing erect. Understand?"

Subject : "Ja".
"Yes".

VI. The frame

Tester : "Muhle. Yena kona lo munye mpahla futi; lo yena lo freyim. Wena buka yena?" (tester rotates it).

"Good. There is other equipment too; this; this is the frame. Do you see it?" (tester rotates it).

Subject : "Ja".
"Yes".

Tester : "Wena buka yena ... yena hamba? Munye skat yena swayile lapa sayid, munye skat lapa sayid." (tester demonstrates by rotating frame).

"You see it ... it moves? : sometimes this way, at other times that way." (tester demonstrates).

Subject : "Ja".
"Yes".

VII. Subject's job is to align the stick

Tester : "Noko lo freyim yena "cock-eyed", tina funa lo stik streyit fanakalo madoda lo yena mile, fanakalo plank futi. Kanjani tina funa lo

stik?"

"Although the frame be aslant, we want the stick erect like a man standing, and like the plank. How do we want the stick?"

Subject : "Streyit fanakalo madoda/plank"(tester stresses concept of gravitational vertical in the analogy of man standing erect).
"Straight like a man standing upright/plank" (tester stresses concept gravitational vertical in the analogy of man standing erect).

Tester : "Yena lo! Yena lo job kawena. Wena enza lo stik?"
"That's it! That is your job. You make the stick ...?"

Tester and Subject : Streyit fanakalo madoda lo yena mile.
Straight like a man standing erect.

Tester : "Ja, wena enza yena streyit fanakalo ...?"
"Ja, you make it straight like ...?"

Tester and Subject : "Madoda lo yena mile".
"A man standing upright".

VIII. Test trials in light

(Tester moves rod out of alignment with the plank)

Tester : "Kanjani lo stik, manje?"

"How's the stick now?"

Subject : "Yena hayikona streyit".

"It's not straight".

Tester : "Yena hayikona streyit, ja. Lungisa yena. Yenza yena streyit fanakalo madoda lo yena mile."
 "It's not straight, yes. Correct it. Make it straight like a man standing erect."
 Subject : (Operates) "Yena streyit fanakalo madoda lo yena mile".
 "It is straight like a man standing erect".

(The practice is repeated for another position of Rod and plank disalignment, with frame also slanted - frame never at 28°).

Tester : "Nyanis! - Munye skat tina swaya lo stulo, fanakalo." (Inclines the chair to the right, and then to the left). "Munye skat wena hlala streyit" (Returns chair to the upright position).
 "Precisely! - Sometimes we slant the chair (position) Thus (Inclines chair to the right, and then to the left). Sometimes you sit upright" (Returns chair to the upright position).

IX. Screen

Tester : "Skat lo yinto lo yena vala lo mehlo yena valile, hayikona sebenza ndaba wena hayikona buka lo job. Susa lo sandla lapa kalo vili skat lo mehlo ka wena yena valiwile.
 Manje tshela mina: Yini wena fanele enza skat lo yinto lo yena vala lo mehlo yena kona

pambili kalo mehlo ka wena?"

"When this screen is in front of your eyes do not work because you cannot see the job. You remove your hand from the wheel when your eyes are screened.

Tell me now what you must do when this screen is in front of your eyes?"

Subject : (Repeats instructions which are explained again if he has not understood properly).

X. Lights are off

Tester : "Skat wena joba, skat wena lungisa lo stik, tina cima lo malambu." (Switches light off) (5 minutes' dark adaptation).

"During your work, when you are correcting the stick we have the lights off". (Switches light off).

XI. Head Position

Tester : "Faka lo kanda ka wena lapa. Hayikona kipa yena". (Indicates the head rest).

"Put your head in here. Don't remove it". (Indicates head rest).

PRACTICE TRIALS

1. Lights off

(Screen moved in front of subject's eyes; chair is tilted to the right; the rod is rotated clockwise. Screen is shifted aside).

2. What do you see?

Tester : "Kuluma. Yini wena buka?"
 "Speak. What do you see?"

Subject : "Mina buka lo stik".
 "I see the stick".

Tester : "Kanjani yena hlalile?"
 "How is it standing?"

Subject : "Yena wile. Yena hayikona streyit".
 "It has tilted. It is not straight".

3. What are you going to do?

Tester : "Manje yini wena azi yenza? - Tshela tina zonke".
 "Now what are you going to do? - Tell us all".

Subject : "Fanakalo yena wile, mina azi enza yena
 streyit".
 "Because it is tilted, I will make it straight".

Tester : "Ja, yenza yena streyit. Manje zonke skat wena
 buka yena swayile, yenza yena streyit fanakalo
 madoda lo yena mile pansi. Mina hayikona azi
 kuluma futi. Na wena hayikona kuluma. Wena
 lungisa lo stik zonke skat yena wile."
 "Yes, make it straight. From now on each time
 you see it tilted, make it straight like a man
 standing on the ground. I will not speak from
 now on; neither will you. You will right
 the stick each time you see it aslant".

4. Procedure

- Tester : (Moves screen in front of Subject's eyes; tilts chair to the left; rotates rod clockwise. Shifts the screen off Subject's eyes. Subject performs task).
- *Subject : "Yena streyit manje".
"It is straight now".
(4 PRACTICE TRIALS)

PROCEDURE FOR TEST

- Tester : (Moves screen in front of Subject's eyes; tilts chair to the right; rotates rod anti-clockwise. Shifts the screen off Subject's eyes).
- Subject : (Same response as above*; proceeds to the next trial, next, and next to the 8th. The chair is now returned to upright position and test continues to the 12th trial. Same verbal response after each trial; "yena streyit manje".
- Tester : (The only exchange between the Testers during these trials (1-12) is the instruction - stop; relating to the position of the rod, that is adjusted by one Tester whilst the other watches the angular rotation of the protractor on the same axle as the rod).

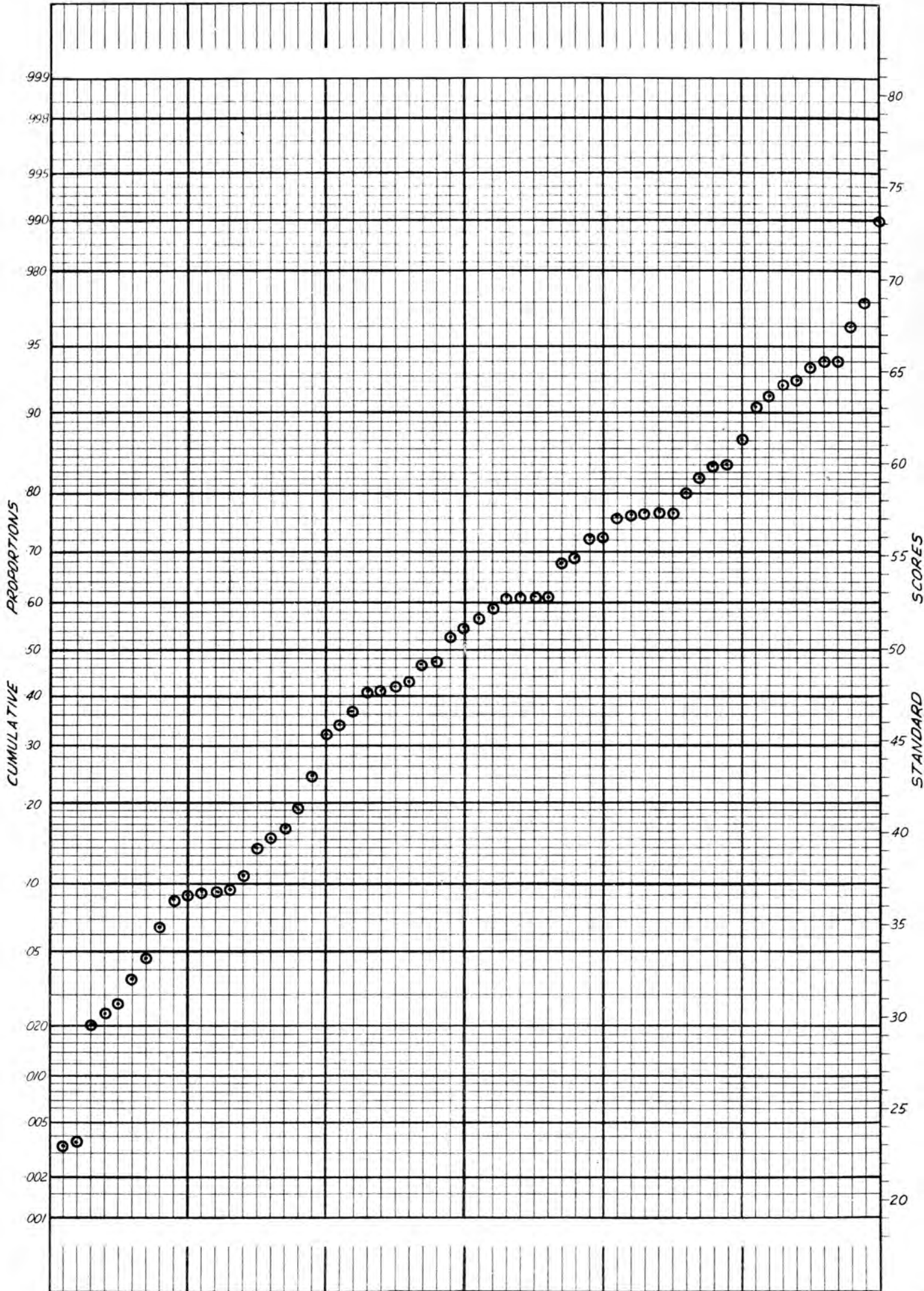
PROCEDURE

End of 12th trial. Lights go on.

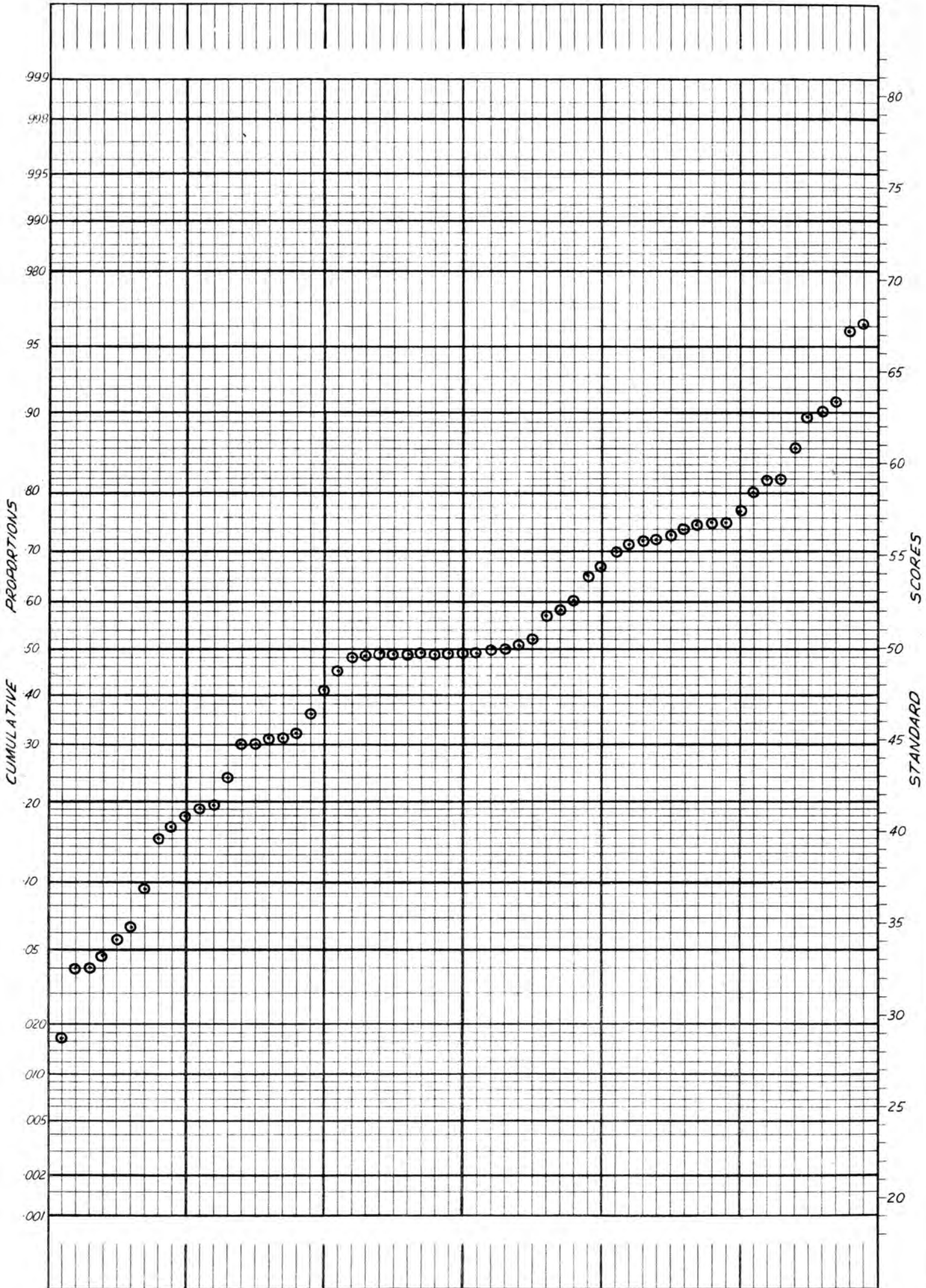
APPENDIX D

SERIES I

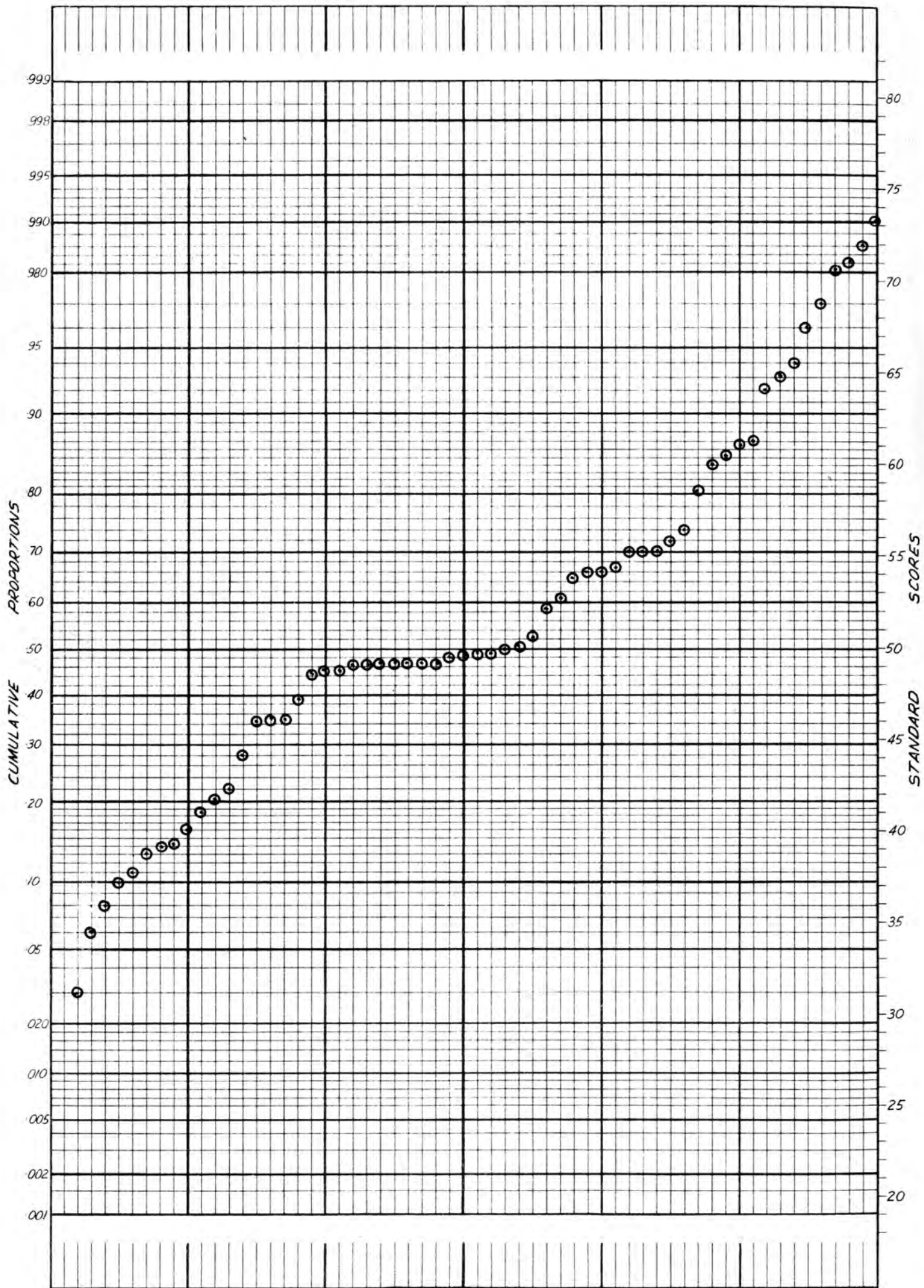
NORMAL PROBABILITY PAPER



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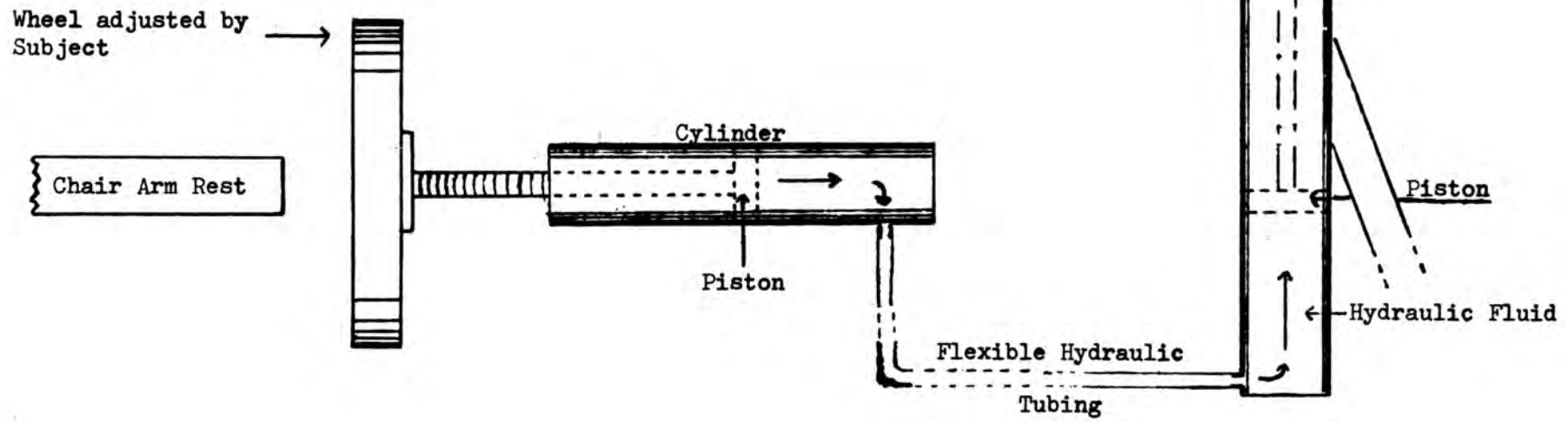
APPENDIX E .SERIES I

	<u>TREATMENT</u>		<u>OBSERVATION</u>	
1	A	B	37.0	52.5
2	B	A	38.0	28.0
3	A	B	29.0	42.0
4	B	A	37.5	26.0
5	A	B	39.5	48.5
6	B	A	48.5	44.5
7	A	B	62.5	74.5
8	B	A	41.0	31.5
9	A	B	21.5	25.0
10	B	A	73.0	77.0
11	A	B	22.0	31.5
12	B	A	61.0	41.5
13	A	B	50.0	98.0
14	B	A	65.5	52.0
15	A	B	60.5	71.5
16	B	A	71.5	60.5
17	A	B	40.0	44.5
18	B	A	44.0	37.5
19	A	B	53.0	57.5
20	B	A	31.5	18.5
21	A	B	44.5	61.0
22	B	A	56.5	45.5
23	A	B	66.5	74.0
24	B	A	67.0	57.5
25	A	B	23.5	30.0
26	B	A	65.5	54.5
27	A	B	48.0	44.0
28	B	A	45.0	35.5
29	A	B	61.0	69.5
30	B	A	65.0	60.0

<u>SERIES II</u>					
	<u>TREATMENT</u>		<u>OBSERVATION</u>		
1	A	B	10.0		14.0
2	B	A	19.0		15.0
3	A	B	18.0		22.0
4	B	A	31.0		25.5
5	A	B	11.5		17.5
6	B	A	19.0		17.0
7	A	B	58.0		64.0
8	B	A	42.5		36.0
9	A	B	23.5		25.0
10	B	A	59.5		55.5
11	A	B	36.0		47.0
12	B	A	25.5		24.0
13	A	B	22.5		44.5
14	B	A	37.5		28.0
15	A	B	29.5		35.0
16	B	A	29.5		21.5
17	A	B	26.5		32.5
18	B	A	23.0		18.0
19	A	B	48.5		62.5
20	B	A	12.5		13.0
21	A	B	23.0		33.5
22	B	A	55.5		41.5
23	A	B	31.5		40.5
24	B	A	16.5		14.5
25	A	B	59.5		58.0
26	B	A	24.5		26.5
27	A	B	41.0		60.5
28	B	A	48.0		43.0
29	A	B	48.0		44.5
30	B	A	43.5		40.5

	<u>SERIES III</u>			
	<u>TREATMENT</u>		<u>OBSERVATION</u>	
1	A	B	11.5	15.5
2	B	A	42.0	29.5
3	A	B	15.5	22.0
4	B	A	5.5	7.0
5	A	B	10.0	18.5
6	B	A	24.5	20.5
7	A	B	50.5	60.0
8	B	A	42.0	31.0
9	A	B	22.5	21.5
10	B	A	59.5	48.5
11	A	B	47.5	52.0
12	B	A	37.0	30.5
13	A	B	21.0	33.0
14	B	A	31.5	26.5
15	A	B	23.0	23.5
16	B	A	25.5	23.0
17	A	B	26.0	24.0
18	B	A	20.5	17.5
19	A	B	53.5	58.0
20	B	A	9.5	8.5
21	A	B	11.5	21.5
22	B	A	33.0	21.5
23	A	B	27.0	33.5
24	B	A	21.5	12.5
25	A	B	24.0	31.0
26	B	A	13.0	9.5
27	A	B	38.5	41.5
28	B	A	53.5	49.0
29	A	B	28.5	45.5
30	B	A	54.5	51.0

HYDRAULIC SERVO-MECHANISM FOR ACTIVATING ROD FROM THE CHAIR



APPENDIX F.

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