A NEW METHOD FOR DETERMINING PERCEPTION OF VERTICALITY

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CHAPTER I

STATEMENT OF PURPOSE

The rationale behind this study hinges on observations made in two different areas of social psychology: norm formation in natural groups and communication theory. MacNeil (1967), in his study of the experimental formation of social norms by natural groups, observed that high status members [those showing the greatest relative amount of effective initiative] conformed more readily to the arbitrary norm in a synthetic group situation than did low status members. He attributed this finding to the fact that high status members must necessarily be more sensitive to social cues than low status members.

In communication theory, Hovland, Janis and Kelley (1953) and Hovland and Janis (1959) observed that a certain segment of their experimental population was more susceptible to persuasive communications regardless of topic, communicator, or approach. They titled this phenomenon the communication-free or general persuasibility factor. It would follow that this set of more persuasible individuals would also be more sensitive to the social environment.

Therefore, a hypothesis could be formulated that a positive relationship exists between the general persuasibility of an individual and his status in a natural group. One possible method used

to link these two variables experimentally would be the Witkin (1954) device for measuring field-dependence and field-independence.

In short, the present experimenter was initially interested primarily in the relationship between status and persuasibility--the fact that, in both situations, a subdivision of individuals seems to react in a manner distinguishable from other individuals. It seemed that, in both cases, the high status and more persuasible individual is particularly sensitive to social cues and finds it more adaptive to conform to the evidence he gathers from these social cues than to depend on the physical reality of the situation. In other words, the individual has two choices--to focus his awareness on the social reality in the stimulus situation or to depend on the physical reality which is also a part of the situation. High status individuals have found it necessary, in order to retain their position of power in the group, to be especially sensitive to social cues around them. Low status persons, on the other hand, have little need for the development of increased sensitivity to social cues, since their social and physical realities are merged for them by the high status member.

Sherif and Sherif have most adequately stated the research position held by the experimenter with regard to this field of study:

> Which individual will occupy what status position, and which individual will succeed in changing his position rests on unique personal characteristics of individual members--their contribution relative to the demands of group activities in which certain personal characteristics matter / Sherif & Sherif, 1969, p.273 /.

The independent variable, status, would be operationally defined as the relative amount of effective initiative attributed to each member of a natural group, with the high status member exhibiting

more effective initiative than the low status member (Sherif & Sherif, 1964). The dependent variable, general persuasibility, would be operationally defined as a relatively high or low score on various techniques used by Witkin, Lewis, Hertzman, Machover, Meissner, and Wapner (1954) to assess the degree of field-dependence and of field-independence within a population of subjects.

The above considerations led to an extensive analysis of the Witkin rod-and-frame device as the proper tool for the study of persuasibility as related to status. Results from that survey, in turn, invited some speculation as to the usefulness of the tool as it was normally administered. The conclusion of the present experimenter was that, in order to obtain a reliable and valid measure of the persuasibility of different status members of groups, it would be necessary to modify the method to produce such results.

Less than forty years ago, perception of verticality was an attested but unstudied field. Researchers, at that time, considered man's ability to position the upright a reliable and stable phenomenon and therefore unsuitable for continued study. However, when aeronautics reached a level of competence wherein man found it essential to organize the dimensions of up and down outside a stable field of organization, it was discovered that perception of verticality could not only be distorted but completely reversed (Asch and Witkin, 1948a).

Asch and Witkin (1948a), the major proponents of the study of perception of verticality, lamented the fact that this area of perception had been ignored for so many decades. They stressed the fundamental importance of vertical orientation in everyday life and stated that

avoidance of the study of verticality was promoted by its major characteristic (its stability under normal conditions). However, they accentuated the fact that this stability could be extinguished when the conditions under which verticality is estimated are found to be relatively more fluid.

Since the latter has been found to occur during airplane flight, the Armed Forces became interested in the study of verticality in an attempt to pinpoint some solutions for the many disasters attributed to the inability to adequately detect true vertical (Passey & Guedry, 1949). Research was carried out to ascertain those characteristics essential to correct perception of verticality.

As the search for those characteristics upon which correct perception of the vertical is dependent were intensified, the perception of the vertical was segmented further into perception of orientation under conditions of the perception of nonvisual space and of the perception of visual space.

Perception of Nonvisual Space

The perception of nonvisual space dealt with the ability of the subject to orient his own body to a standard or objective vertical position. The task was investigated in three situations: (1) under normal conditions; (2) modified somesthetic conditions; or (3) with the visual framework present. Adaption effects were also examined.

Under Normal Conditions

In general, under normal conditions, perception of body tilt was extremely accurate. Burtt (1918) and Kleinknecht (1924) concurred that

subjects were sensitive to even the slightest changes in tilt, that accuracy was greater with rapid than with slow tilt, and that no practice effects were evidenced.

A mean constant error of 0.8 degrees was computed for those subjects returning to vertical from lateral tilts and uncertainty increased as the distance between set position and vertical decreased (Mann, Berry & Dauterive, 1949). Mann et al. (1949) also found that error increased when the chair was kept in constant motion and the subject required to sound a buzzer as he passed vertical. Passey and Guedry (1949), after examining tilts in both the medial and lateral directions, concluded that accuracy was greater for the lateral tilt.

When knowledge of results was considered, Berry and Dauterive (Mann, 1950) found no differences due to knowledge of results plus no significant practice effects. However, after testing various angles of tilt, practice effects were discovered by Corrigan and Solley (Mann, 1950) for the single tilt angle of 30 degrees.

Modified Somesthetic Conditions

Under normal somesthetic conditions, all appropriate sensory modalities will enter into any decision concerning true positioning of the body to vertical. Therefore, researchers undertook experiments to investigate the effects of changed or reduced somesthetic conditions.

Backhaus (1918) studied the effects of supported versus nonsupported head position by establishing three conditions: free-moving head; head moved irregularly by the experimenter; and supported head. The results showed no decrease in accuracy as the amount of head support decreased.

Garten (1920) noted an increase in variable error when the lower portion of the body of each subject was chilled by inserting the chair into water. When soft versus hard seat was investigated, Mann, Berry and Dauterive (1949) and Mann and Passey (1949) found an increase in variable error for the soft-seat condition.

Adaption Effects

The study of postural vertical convinced some scientists that adaption to tilt could occur under described conditions. Mann and Ray (1956) subsequently investigated the effect of both delay of response and rate of movement from non-vertical to vertical position. Following an analysis of variance, which showed significant delay and rotation effects, individual comparisons were done. In general, it was found that both increased delay of response and increased speed of rotation increased variable error.

Consistent with this generalization were the results from a series of studies investigating adaption effects under various conditions of delayed tilt. These studies showed that variability of judgments increased as delay of response in the tilted position increased (Passey & Guedry, 1949). The variability was increased to an even greater extent when padded rather than nonpadded seats were used (Mann et al., 1949; Mann & Passey, 1949). However, an experiment undertaken by Mann and Passey (1950) found no increase in variability as the duration of exposure to tilt or the magnitude of tilt increased.

In another area of adaption effects, Clark and Graybeil (1961) studied the effects of practice when dealing with postural vertical. Two groups of subjects were used; a normal group and a group whose

members exhibited vestibular inadequacies. Little difference was found between the two groups of subjects with regard to extent of error and both groups evidenced an increase in precision with practice, even though the practice trials were not carried out while the subject was seated in the chair, but while the subject was standing next to the chair before taking his seat. Furthermore, the experimenters stated that performance within the experimental situation was optimal due to the following factors: the subject passed through vertical following each trial and was allowed to adjust the chair through vertical while arriving at perceived vertical; knowledge of results was given to each subject by the experimenter by placing the position of the subject at actual vertical before initiating the next trial; a hard seat was used as well as a head rest and shoulder straps; and the subject returned himself to vertical immediately with no delay in the tilted position.

In 1963, Clark and Graybeil extended their study to the difference in dealing with postural vertical of normal and vestibular patients by measuring their accuracy under different intervals of delayed body tilt. It was found that those subjects with vestibular problems made even more errors than did the normal subjects in the delayed tilt situation even though the accuracy of the normal subjects decreased. Furthermore, the effects of the delayed tilt increased as the extent of tilt increased.

The Visual Framework

Study of the alignment of postural vertical when the visual framework was present was initiated due to an argument concerning the

predominance of either visual or postural cues when assessing vertical. Witkin (1949), using a tilting chair and tilting room, examined the effect of either visual or postural cues by judging degree of accuracy when adjusting the body to postural vertical under varying conditions: chair upright, room 35 degrees left or right; chair 22 degrees left, room 35 degrees left or right; chair 22 degrees left, eyes closed. The following results were found: when the chair was tilted but the eyes remained closed, postural factors established correct body position [there was no conflicting visual factor]; error increased as room and chair were both tilted and there was greater error when the room and chair were tilted in the same quadrant; the decrease in error when the room and chair were tilted in different quadrants was explained by the fact that the chair, in this case, not only felt but looked tilted and that a shift in position was evidently essential; and, in all cases, the range of individual differences was large.

In a second phase of the above experiment, subjects were placed in one of two experimental groups or one of two control groups. The first experimental group (E1) was instructed to bring their bodies to the position where there was no pressure on either side of the body. The chair and the room were both tilted 30 degrees in the same quadrant. Experimental Group II (EII) was given the same instructions but the room and the chair were tilted 30 degrees in opposite quadrants. The first control group (C1) differed from the two groups of experimental subjects only in the phrasing of the instructions: they were told only to place their bodies in an upright position. Subjects in the second control group (CII) were under exactly the same conditions as C1 except for the fact that their eyes were closed during the entire experiment.

The results showed that under both E1 and EII, the body was often perceived as straight when actually it was tilted (mean error was 13.3 degrees for tilt in the same quadrant and 7.8 degrees for tilt in opposite quadrants). Comparison of results for E1 and EII and C1 exemplified the fact that the instructions used during the experimental situations decreased error (greater error was found in the control than in the experimental groups). Comparison of results for E1, EII and CII pointed out the much greater error which occurred when the visual stimulus was present. This led to the conclusion that visual factors are important when aligning the body to postural vertical.

Passey (1950a) also tested the relative strengths of visual and postural cues when aligning the body to vertical. He found that when both visual and postural factors were present, subjects tended to rely primarily upon postural factors [this is in direct conflict with Witkin's (1949) findings, that visual factors will be relied upon more than postural factors]. He also found that mean constant error increased due to nonalignment of visual and postural factors and that this increase was even greater when the visual and postural cues were positioned in the same quadrant. Passey stated that the conflicting results between Witkin's (1949) work and his own findings were due to the stronger cues elicited by the more structured frame used in the Passey studies. [Structure is considered the relative availability of external versus internal cues with structure increasing as the number of external cues increase.]

Mann (1950), after reviewing the above two studies, came to the conclusion that, in both cases, the errors made by subjects were nearer to the gravitational vertical than to the visual vertical.

He considered this fact evidence for the conclusion that gravitational factors were more important in adjusting the body to vertical than were visual factors.

> If the visual framework is predominant, one would expect a far greater shift of constant error than is obtained in these experiments. It should also be stressed that in these experiments the conflict is between visual and somesthetic cues; not between visual and gravitational cues. The tilting of the individual so that the main line of his body from head to seat is not in line with the gravitational vertical changes neither the magnitude nor the direction of the gravitational force. . . . The shift is small enough to warrant the inference that the tilted visual framework is a distracting element rather than a dependable guide in the judgment of the postural vertical /p. 77.

Perception of Visual Space

Perception of visual space is defined as the ability to adjust some outside visual stimulus to the position of visual vertical. This technique was examined by using as the visual stimulus a rod, a pointer, or a room under four situations: normal conditions, visual conflict, postural conflict, and visual and postural conflict.

Under Normal Conditions

When there is no counter cue arising from postural displacement, the perception of visual vertical was extremely accurate. Mann et al. (1949) found no significant difference between perception of vertical and perception of horizontal. With regard to error, Noble (1949) reported a .38 degree constant error in 480 judgments and Witkin and Asch (1948a) computed an average error of 1.5 degrees.

Visual Conflict

Visual conflict was characterized as the situation in which two visual stimuli were presented, one of which tended to alter the perception of the other. Often other extraneous stimuli or delay of judgment were used to point out the apparent instability of visual perception.

Gibson and Radnor (1937) investigated the subjective placement of vertical after various time lapses before judgment. They found that tilted lines appeared less tilted after periods of observation, the effect being the greatest at ten degrees and disappearing when the line was tilted 45 degrees. In another phase of the experiment, subjects were asked to close their eyes for a period of time (from five to 60 seconds) and the line was positioned at objective vertical. The subject was then asked to position the line at subjective vertical. An adaption effect was substantiated up to 45 seconds.

The idea of two conflicting stimuli was examined by Gibson (1937) by overlaying a straight line with a grid of parallel lines. When the grid was tilted either to the right or to the left, the line was seen as tilted in the opposite direction. Asch and Witkin (1949) also investigated the effect of one visual stimulus upon another. Subjects were asked to observe a room through a tube--the room contained a rod which the subjects were to align to vertical. The mean value of errors when the room and the rod were tilted to different degrees and in different or the same quadrants were 21.5 degrees and the range of error was from six degrees to 34 degrees. Generally, a stimulus conflicting with the one to be aligned increased error in judgments of verticality.

Wapner and Werner (1951) engaged in a study testing the effects of extraneous stimuli on the perception of visual vertical. The following extraneous stimuli were used: electrodes to the right and left sides of the neck; and auditory stimuli through headphones. Three basic findings were that: (1) visual perception is affected by extraneous stimuli; (2) both kinds of extraneous stimuli (neck stimulation and auditory stimuli) functioned in the same manner; and (3) individuals were consistent with regard to the average deviation of the rod from objective vertical.

Postural Conflict

Postural conflict occurred when the subject was required to estimate true verticality of the target item when the postural vertical was altered. Witkin and Asch (1948a) confirmed the fact that with the body at the upright position, visual vertical and horizontal were accurately perceived. However, when the body was tilted judgments were affected, especially when the subject position and the rod position were initially in opposite quadrants. The subject position was tilted at either 28 degrees, 45 degrees, or 90 degrees while the rod was tilted at either horizontal or vertical or 28 degrees to the right or to the left. Witkin and Asch also found that when the body and the rod were initially tilted to the same side, the rod was displaced 74.1% of the time to the opposite side of vertical and when the body and the rod were tilted initially in opposite quadrants, the rod was displaced to the near side 81% of the time. With large body tilts the rod was displaced opposite in direction to the body while with smaller body tilts the rod was displaced toward the body. Individual differences were large in all the tilt conditions.

Visual and Postural Conflict

In order to study which of the two factors, postural or visual vertical, had the greatest effect on the perception of visual vertical, psychologists used both postural displacement (through, usually, differentiated chair tilt) and visual displacement (through the use of a frame which could be tilted in varying degrees around the rod). This issue was examined experimentally in three major studies (Boring, 1952; Mann & Boring, 1953; Witkin & Asch, 1948b).

In 1948b, Witkin and Asch developed the frame which was to be used as a simple means of changing the position of the field so as to obtain different field positions. The normal field was removed by working in a darkened room and the illuminated frame could be set at varying positions so as to provide different surrounding positions for the rod placed within it. In their experiment, subjects were asked to adjust the rod to true vertical or horizontal when the frame and the chair were at different positions. On one-half of each set of 12 trials the rod was initially tilted to 28 degrees to the left or right in the same direction as the frame (tilted 28 degrees) and to the opposite direction from the frame on the last half of the twelve trials. The body was positioned erect or was tilted 28 degrees to the left or to the right. The experimenter moved the rod until the subject stated that the rod was straight. It was found that tilting the frame produced errors which supported the hypothesis that the frame affected visual perception of vertical: when the frame was upright and the body was tilted, errors were smaller than when both the rod and the body were tilted. Also, when the body was tilted in the same direction, errors were greater but

when the body and frame were tilted in opposite directions, 80.1% of the errors made were in the direction to which the frame was tilted.

Witkin and Asch (1948b) also reported great individual differences:

> It was evident from these ranges that some Ss were able to judge the upright fairly accurately, despite the tilted frame, indicating some independence of field. At the opposite extreme were those subjects who showed a ready tendency to accept the tilted field as the frame of reference [7, p. 768].

Consistency of performance for the different sets of tilt of frame and body showed that when the body erect-frame tilted position was compared to body and frame tilted in the same direction position, the correlation (r) equaled .53. When the body erect and the frame tilted position was compared to the body and frame tilted to opposite sides, the correlation (r) equaled .50. And when the body and frame tilted to the same side was compared to the body and frame tilted to opposite sides, the correlation (r) equaled .52.

In a second phase of the experiment, Witkin and Asch substituted a smaller frame for the more simple rod used in the former experiment. The larger frame was still present with the smaller frame located within it. It was found that, as in the case of the rod, perception of the position of the small frame was affected by the position of the larger frame.

A third phase of the experiment asked the subject to reproduce the angle of the rod which he had examined for one minute (15 degree angle). On five trials the frame within which the rod was placed was straight, and after those five trials was tilted 15, 30, 45, and 60 degrees. The above series was repeated four times by each subject. Reproduction was found to be relatively accurate when the frame was

upright but decreased when tilt of the frame accompanied tilt of the rod. Errors always occurred with the rod set toward the position of the frame away from true vertical.

With regard to subjective analysis, Witkin and Asch concluded that some subjects tended to become confused and anxious concerning their judgments, especially those who were dependent upon the frame but tried to use the position of the body to make correct judgments of visual vertical. This observation was supported by the fact that when training was introduced, for this type of subject, confusion and anxiety were increased. If the frame was removed, the problem was seen as much simpler and the anxiety lessened.

Witkin and Asch also compared the various devices that had been used in this and previous studies to represent the surrounding field in the judgment of the position of a luminescent rod. Witkin and Asch reported that the luminescent frame was the simplest and also provided the most structure, followed by the tilted room and finally the reflecting mirror. This greater structure also caused greater consistency in judgments since the average error was lessened.

Boring (1952) also estimated the effect of the frame on the judgment of visual vertical. Two types of frames were used: a luminescent straight line and a window pattern with bisecting lines. The rod (target item) was located directly in front of the frame. The frame, chair and target were tilted in varying degrees or sets using the coordinates: 30 degrees left, 0 degrees and 30 degrees right. Boring found no significant differences when different combinations of the above three conditions were compared. Boring explained his findings by hypothesizing that the effect of the frames

was not strong enough to cause any conflict with postural factors and, thus, due to the fact that no conflict existed, there were no discrepancies in errors among the various conditions. He found, however, that constant error tended to be in the direction of body tilt /¯ which is opposite to Witkin and Asch's (1948b) findings _/ but felt could be explained through the inability of the frames used in this particular experiment to arouse any conflict between postural and visual cues.

Mann and Boring (1953) used two types of frames: a luminescent straight line and a window pattern. Again, the chair, the frame and the rod (target item) were inclined at 30 degrees left, 30 degrees right, and 0 degrees. Two types of subjects were used: naive subjects who were merely told to set the rod to true vertical and sophisticated subjects who were informed as to the experimenter's expectations of true vertical and were encouraged to ask questions and then practice. Mann and Boring found large individual differences and greater errors for the naive than for the sophisticated subjects. The result of the study was that Mann and Boring explained Witkin and Asch's (1948) findings on the premise that they had failed to impress their subjects with a structured definition of vertical and then each subject made his own choices about the nature of vertical which, in turn, caused greater variability among subjects as to the direction of visual vertical. Mann's (1952) instructions, on the other hand, were like those used for the sophisticated subjects which explained the decrease in individual differences and the tendency toward less error than that found by Witkin and Asch in experimental results.

Problems Implicit in Basic Literature

In general, after the discovery that various factors affected the perception of verticality, study was extended in various directions leading to the discovery that visual and postural vertical differed in many respects. Interest in many variants which were seen to control perception of verticality led to the investigation of their effect.

However, although the basic method introduced by Witkin and Asch (1948) remained more or less the same, each experimenter used his own apparatus, instructions, and control measures. It has been found that all these factors could affect perception of verticality which in turn, made comparison between studies practically impossible. Discrepancies between results were explained through differences in methodology and procedure rather than being considered as valid indicants of whether the basic theory behind perception of verticality was intrinsically correct or incorrect.

The present experimenter, after reviewing the literature, found contradictory assessments of the factors affecting vertical. These conflicting results suggested that the methodology used should be studied and examined more closely . . . perhaps modified, perhaps changed completely.

CHAPTER II

STATEMENT OF PROBLEM

As work on perception of verticality progressed, proponents of the rod and frame studies concerning perception became more and more interested in the idea that perceptual theories had been ignoring two basic factors, motivation and personality. These proponents felt that motivation and personality factors should be studied in dealing with any human psychological processes.

Subsequently, Witkin noticed a vast difference in reactions of subjects when aligning the visual target to vertical or when establishing postural vertical in the presence of visual dissonance. This concept was elaborated in 1954 by Witkin et al.

> Fairly large groups of subjects were employed, and ... it was found that responses of individuals, upon which group means were based, covered a very wide range. Because of this great variation among subjects, no conclusion about the nature of perception under a given condition, derived from average values for the group, held true for all members of the group. This indicated that a full understanding of the process of orientation one must go beyond group results and determine the factors responsible for variation among individuals [pp. 8-9].

When examining the wide range of performance obtained by subjects, it was noted that at each extreme end of a continuum denoting ability to align either the target item or the body to objective vertical was a distinct type of person. Those people who made more errors in performance seemed to depend upon the visual field as the standard

for correct positioning of vertical, and those persons with fewer errors appeared to be unaffected by the visual field and determined objective vertical by body position. The former were classified as field-dependent (FD) and the latter as field-independent (FID). Each extreme group was found to perform in a consistent manner both between tasks and within tasks. Also, it was stated that training did not seem to affect the initially preferred method of responding but forced the subject to attend in greater magnitude to the task at hand.

With regard to developmental changes in perception, Witkin et al. found that young children tend to be more FD while children between the ages of ten and thirteen showed a reversal of this trend and were affected primarily by body position. Females showed a greater dependence upon the field than did males at all age levels, with the difference between males and females widening to the greatest extent in adulthood.

Through case histories, the Rorschach and the Thematic Apperception Test, Witkin et al. arrived at various personality characteristics which he found to be associated with either FD or FID modes of perception. The first characteristic differentiating the two was called the amount of activity shown in dealing with the environment. FD individuals were considered to be of the passive variety whereas FID individuals were much more active. That is, FID persons needed little support from the environment when conceptualizing and organizing stimuli and dealing with environmental forces.

With regard to handling of internal impulses, FD individuals were hypothesized as being aware of inner emotions, fearful of sexual

and aggressive impulses, and having poor behavioral control. They also suffered from high levels of anxiety. FID subjects reacted in the opposite manner to internal impulses and were characterized by low levels of anxiety.

When dealing with personal self-evaluation, FD persons showed low self-esteem, an inability for self-acceptance, and low bodily evaluation while FID persons were high in all three of the above mentioned traits.

Witkin's statements concerning the wide variety of traits which were correlated with FD and FID modes of perception in turn launched a great deal of research (Witkin et al., 1954). Experimenters realized the facility of the various tests measuring FD-FID in their potential usefulness if correlated with such groups as alcoholics, schizophrenics, leaders, etc. in such a way as to allow for the determination of potential membership in those groups through the use of a single test. Therefore, this train of thought led to a great amount of research correlating FD-FID with major processes in the various areas of psychology.

In the field of clinical psychology, FD-FID was correlated with performance in response to distraction (Houston, 1969) and authoritarianism, need for achievement, and the total Minnesota Multaphasic Personality Inventory (Adevai, Silberman & McGough, 1968; Clark, 1968; McFall & Scenkein, 1970). Data were also gathered dealing with personality characteristics and disorders such as schizophrenia (Sugarman & Cancio, 1968), defense mechanisms (Okilevich, 1968), rigidity (Breskin & Gorman, 1969), distance from child to parent of the same sex (Lynn, 1969), and cognitive style with relation to

personality defenses (Schimek, 1968). Field dependence was extended to that area dealing with social problems which are considered to contain some personality components such as alcoholism (Jacobson, 1968; Klappersack, 1968; Krustofferson, 1968), enuresis (Scallon, 1969; Scallon & Huron, 1969), and diabetes (Karp, Winters & Pollack, 1969). Other experimenters related FD to expectancy for success (Deever, 1968), "Philosophies of human nature" (Duke, 1969) and creativity (Gensemer, 1968). The relationship between vocational interest and FD-FID was also a topic of study (Arbuthnot & Gruenfeld, 1969).

Psychologists interested in human learning also used the Witkin devices in order to relate FD-FID to those personality factors involved in many learning tasks. Information utilization (Dubois, 1969), attention development (Schimek & Wachtel, 1969), and arousal and memory for incidental material (Fitzgibbons, 1969) were some relevant topics. Also included were cue conflict (Barrett & Thomton, 1970), effect of feedback on counting rate (MacDonald & Dauson, 1970), and learning differences between reward seekers and punishment avoiders (Bell & McManis, 1968). Differences in ability to perform tasks such as the visual maze task (Gorman, 1968) and the auditory signal detection tasks (DeFazio & Morony, 1969) was also investigated.

With regard to physiological psychology, much work was submitted dealing with various visual factors which could be explained through the use of the FD-FID continuum: eye movement patterns (Boersma, Muir, Wilton & Barham, 1969a; Boersma, Muir, Wilton & Barham, 1969b; Concline, 1968); eye dominance (Nadren, Scaffer & Schmeidler, 1969);

and figural after effect potency (Immerglick, 1970). Differences between normal and neurologically impaired subjects were also examined (Trites, 1969).

Social psychologists were also interested in relating various phenomena to the subject categories of FD-FID. Solar, Davenport and Bruehl (1969) examined the relationship between compliance and FD-FID. Leadership was studied as a function of either previous leadership status (Daugherty & Waters, 1969) or ratings of least preferred coworkers (Gruenfeld & Arbuthnot, 1968, 1969). Social isolation was another sub-area which received its share of attention (Astrup, 1968; Zuckerman, 1968). Socially related problems were also investigated including the effect of relocation on the infirm aged (Bloom, Bleukner & Waters, 1969), and the differential effect of socioeconomic status (Karp, Silberman & Winters, 1969).

With regard to the above studies, very few of the researchers mentioned their method of administering the test for FD-FID, stating only whether they had used the rod-and-frame test (RFT) or the embedded or hidden figures test (EFT, HFT). Therefore, again referring to the basic method examined in the literature review, comparison of the various studies was practically impossible since Witkin et al. (1954) found there was a relatively low correlation between the RFT and the EFT. In addition, various factors including instructions to subjects, control factors within the experiment, procedural administration, dimensions of the rod and frame used in that particular experiment, etc., had not been elaborated.

The above criticisms could be generalized to practically all of the current research studying the relationships between human factors

and FD-FID. It would seem that many of the conflicting results could be eliminated through the proposal of a common, standard method in which there would be less opportunity for procedural and experimenter bias to function.

Due to the above conflicting results, various experimenters began to re-emphasize methodological considerations pertaining to the determination of FD-FID. Vaught (1969) measured the FD of 27 males and 25 females using the portable RFT in eight trials and the stationary RFT in the other eight trials. The starting position of the rod in every case was random and the order of presentation was counterbalanced. The correlation of .46 between the two measurements reflects that only 21% of the variance in one measure can be accounted for in the other.

Lester (1968, 1969) discussed the methodology typically used when measuring FD-FID and considered some factors which could be held responsible for the discrepancy in outcomes under different experimenters. Lester cited four factors which were not controlled for in most studies: (1) Random tilting of the head during trials could cause a difference in the displacement of the true vertical and suggested that a bitebar be used to control for any individual differences in head placement; (2) Especially in the RFT, the starting point of the rod and the initial position of the frame could make a great deal of difference in outcome since experimenters failed to provide adequate variation in starting position; (3) In very few cases were control readings taken as to the individual's subjective impression of true vertical--it was merely assumed that subjective vertical was equal to true vertical in all experimental cases;

(4) Different experimental instructions could cause a difference in results. This held not only for explicit instructions but also for implicit instructions. In addition to these four factors, Lester also pointed out the difference in the criterion used by experimenters to differentiate FD from FID persons. Sometimes the cut-off point was given as the mean, in other studies as the median or as different standard deviations from the mean. Often this distinction was not specified in the methodology of each experiment.

Trites (1969) discussed another difference in measurement when he pointed to the fact that in most cases the score for the individual on the RFT and the other orientation tests was the average error from the true vertical, with FID subjects having a lower average error than FD subjects. Trites noted that a measurement which would shed more light on the differentiation between FD and FID was the side favored by the type of subject. His conclusions asserted that those who made more response sets (chose one side over the other) were more FID than those who made less response sets (FD).

Therefore, any methodology considered for use in the standardization of a perceptual unit must include two major problem areas. Those are a standardization of method, preferably including simplification and a means of logically distinguishing between the extreme types exemplified by FD-FID.

In the present study, a modification of the Witkin rod and frame device was assessed in terms of its practicality in measuring the perception of verticality. In this modification of the Witkin measurement technique, the frame was set at either 10 degrees left of vertical, 10 degrees right of vertical, or 0 degrees; the rod was

set at 5 degrees left of vertical, 5 degrees right of vertical or 0 degrees. It was hypothesized that various combinations of the set of the rod and the set of the frame would lead to different responses as to the verticality of the rod. ("Yes, it is vertical." "No, it is not vertical.") The responses, in turn, would be dependent upon whether the subject was influenced by the external environment (the frame) or his own body position.

It was hypothesized that the method explained above would discriminate FD from FID subjects as a function of their performance on varying defined positions of the rod and the frame (See Table 1).

TABLE 1

Hypothesized General Response Styles
("Yes, it (the rod) is vertical."
"No, it (the rod) is not vertical.")
for FD versus FID Ss.

Positions of the rod and frame frame-rod	Categorization of Ss FD	 FID
R L L R	N	N
R O L O	N	Y
O R O L	N	N
R R L L	Y	N
O O	Y	Y

As can be seen in the above table, there were two positions (R-O, L-O and R-R, L-L) which should distinguish between FD and FID subjects. All other positions should require the same responses for all subjects. Therefore, it was predicted that the "Neutral Positions" (R-L, L-R; O-R, O-L; and O-O) would have no effect upon the total difference between subjects and therefore upon the ability to range those scores along a continuum.

It was also hypothesized that subjects would, in general, answer all items on the test in a predictable manner.

CHAPTER III

METHOD

Subjects

Fifty subjects (25 males and 25 females) were randomly selected from introductory psychology classes at Oklahoma State University.

Apparatus

The measuring device was the Witkin rod-and-frame apparatus, permanently mounted in a sound-reduced and light proofed room. A chair (see Appendix A), designed to eliminate all variable head movements and most gross body movements, was placed ten feet directly in front of the rod-and-frame apparatus. Three positions of the rod and three positions of the frame were matched so that all combinations were presented at least once to every S. The positions were as follows: frame = 10 degrees left, 10 degrees right, and 0 degrees; rod = 5 degrees left, 5 degrees right, and 0 degrees. Luminance of the rod and frame was held constant throughout the entire experiment. Luminance of the rod and the frame was set at zero amplitude during times when the E was setting the initial positions of the rod-and-frame. Black opaque goggles were worn by the S during the initial dark-adaptation interval.

Procedure

The room, in order to eliminate an afterglow from fluorescent lights,was left dark for at least three hours prior to experimental use. Each S was dark-adapted for at least ten minutes before entering the laboratory: a pair of opaque goggles, painted black, was used for that purpose. An E of the same sex as the S remained in the dark-adaption room with the S for the period of time.

Each S entered the laboratory and was seated in the chair by the same E who was with him in the dark-adaption room: the S remained seated in the chair during presentation of instructions, allowing further time for dark-adaption. During the instruction period, the rod-and-frame apparatus was visible and set at the vertical position.

The instructions were given as follows:

> Your task in this experiment is to decide whether the rod you see in the window is pointing straight up to the ceiling in the same direction as the walls of this building. You will be shown the rod in the window and when I say "now" you are to answer with "yes" if the rod points straight up to the ceiling in the same direction as the walls of this building and "no" if it does not. A screen will be drawn in front of the rod in the frame after each trial and when the screen is removed, you will again give the answer "yes" or "no" after I say "now." Do you have any questions?

According to the hypotheses presented, FD and FID Ss would differ in only two positions: when the frame and the rod were both tilted in the same direction (R-R, L-L); or when the frame was tilted in either direction and the rod was set at vertical (R-0, L-0). Therefore, a total of eighteen trials were given for the three basic positions where all Ss would be expected to score in the same manner (0-0; R-L, L-R; 0-R, 0-L), and thirty trials were given for

each of those positions where FD and FID Ss would be expected to differ (R-R, L-L; R-O, L-O). A total of 78 trials was given.

In order to control for sequence variables, each S began at a different position on the list of initial sets of the rod and frame. The sequence of the list itself was computed through the use of a random number table.

In order to insure reliable results, data from S who gave incorrect responses in conjunction with those positions of the rod and frame where all Ss would be expected to score in the same manner (O-O; R-L, L-R; O-R, O-L), on more than 10 out of 18 trials were excluded from analysis: the rod-and-frame apparatus was operated by the same E for all Ss.

CHAPTER IV

RESULTS

When the total scores per subject were analyzed (see Appendix B), the scores ranged from 19 to 75 with a variance of 173.50 and a standard deviation (SD) of 13.17; the Mean equaled 39.34. When those scores extending beyond ± 1SD were examined, it was found that nine subjects with scores ranging from 19 to 26 could be classified as FD and seven subjects with scores ranging from 56 to 75 could be classified as FID (see Figure 1). The above computations and the ability to pinpoint FD and FID positions would support the assertion that the method as designed was a useful tool for distinguishing FD from FID subjects.

Number of Correct Trials	f
75	1
74	
73	1
72	
71	
70	
69	
68	
67	
66	
65	
64	
63	
62	
61	
60	2
59	
58	1
57	1
56	1
55	

54		
53		+ 1SD
52		
51	2	
50		
49	1	
48	2	
47	4	
46	1	
45	2	
44		
43	2	
42		
41	1	
40	1	
39	1	
38	2	
37		
36		
35	2	
34		
33	6	
32	1	
31	1	
30		
29	1	
28	3	
27	1	- 1SD
26	1	
25		
24	3	
23	1	
22	2	
21		
20	1	
19	1	

Figure 1. Frequency distribution for number of correct trials with cutoffs for FD-FID status indicated.

A Pearson Product-moment Correlation Coefficient was then computed, showing that the relationship between the discriminating item scores for each subject and the neutral item scores for each subject were not related. A coefficient of .196 was found which was not significant at the .10 level of significance, supporting the hypothesis that neutral items did not contribute to the total score for each subject nor to the formation of the FD-FID positions (see Figure 2).

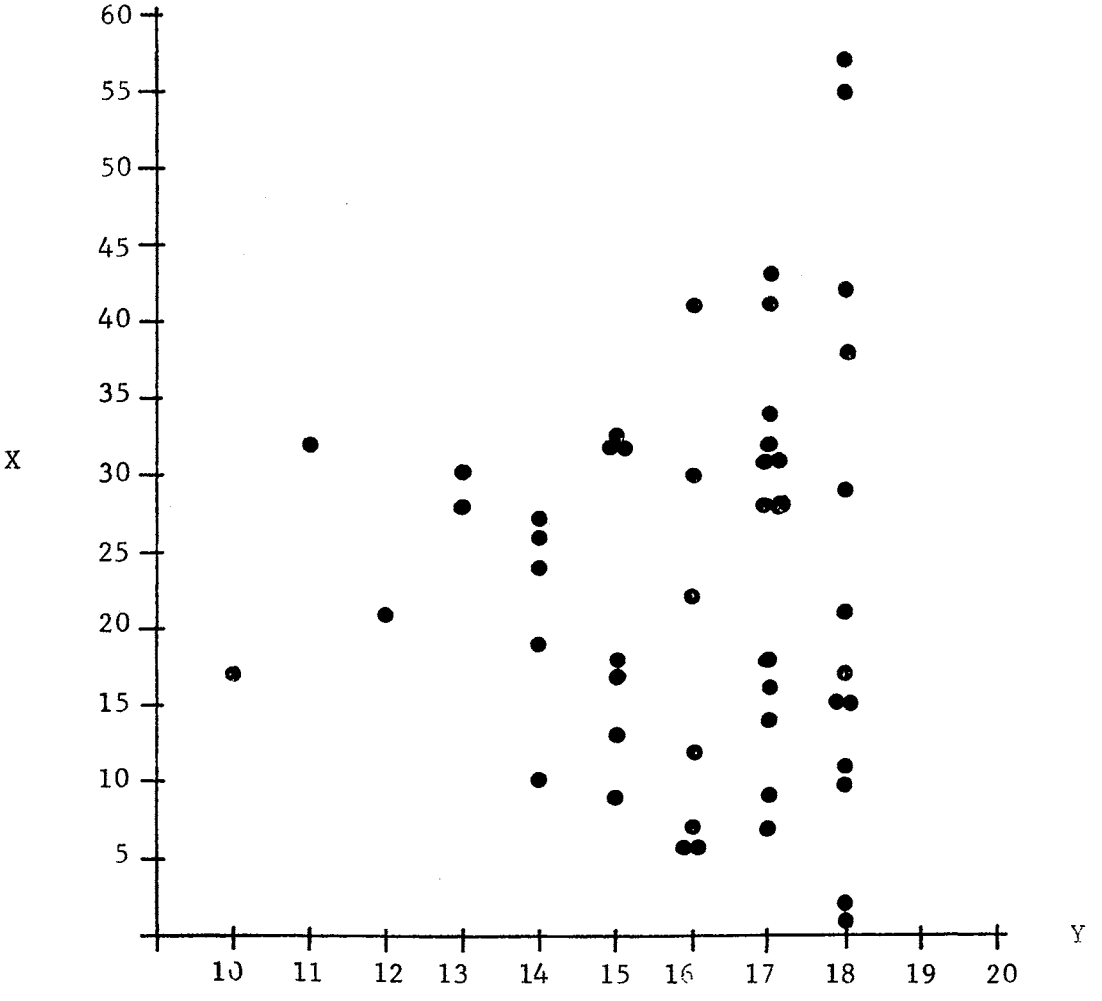

Fig. 2. Scatter-plot showing the relationship between X (discriminating items) and Y (nondiscriminating items)

A Kuder-Richardson (KR20) reliability coefficient of .94 suggested that the responses within the test were very consistent.

CHAPTER V

SUMMARY AND DISCUSSION

In the present experiment, 50 Ss (25 males and 25 females) were tested in order to assess the practicality of a new methodology designed for use with the Witkin rod-and-frame device which would alleviate or eliminate some of the problems inherent in the previously used methodologies.

In previous experiments, subjects were requested to perform one of the following tasks: (1) move the target rod from the position initially set up by the E to true vertical; or (2) inform the E when the target item moved by the E himself reached the vertical position. In the present experiment, conflicting reports, perhaps due to the arbitrary use of the above two methods, were eliminated by asking the S merely to respond with "yes, the rod is vertical" or "no, the rod is not vertical" at varying distances from true vertical.

In conjunction with the above problem, the E, previously, was forced to make a decision as to what method to use to return the rod to a new position after a judgment had been given by the S. The E could move the rod in one single continuous motion or in random degree intervals. Knowledge of results was a factor which presumably could enter in here, since it was necessary, in some instances, for the E to move the rod through vertical in order to reach the next position. The present experimental methodology allowed no such room for error

due to the fact that the S was never aware of the correctness of the existing position of the rod and, therefore, was not influenced by past experience with vertical.

Also, in previous experiments, little mention was made concerning the precautions taken to insure reduced mobility of the S during the testing period which would possibly have been a factor in the explanation of the differential results obtained from previous experiments. Generally, no mention was made of dark adaption procedures. Also, subjects were often asked to close their eyes when the rod and the frame were moved to new positions--a tactic which would seem to invite bias. In the present experiment, the use of a head rest was instigated which allowed little movement of the head or body frame during testing. Dark adaption interval was set to allow maximum adaption and the luminosity of the rod and the frame was adjusted so that the subject could not see either the rod or frame and thereby receive visual cues during movement of the rod and the frame between trials.

In addition, in many of the experiments originally establishing the methodology normally used in the rod-and-frame, care was taken to give a maximum number of trials, but at the same time, the number of subjects employed in each study was reduced. The present E tested 50 Ss using data from 75 trials for each S which would return statistically relevant evidence for the reliability of results both between and within Ss.

Results showed that the methodology used was capable of distinguishing between Ss as exhibited by the large range of scores (19-75) and the relatively large values computed for the variance (173.50) and

the SD (13.17). With regard to the ability of the instrument to categorize FD and FID Ss, when scores that extended beyond ± 1SD from the Mean were grouped, it was found that nine Ss could be classified as FD and seven Ss as FID. This number was the expected result due to the fact that, as in the case of most continua dealing with individual differences, relatively few Ss are found to operate in the extreme style of the characteristic being measured (most Ss tend to utilize a combination of characteristics). However, the number of Ss who could be classified upholds the ability of the method to detect the differential qualities associated with FD and FID Ss.

In order to assess the internal validity of the method, it was essential to insure that the nondiscriminating items played no part in the determination of the positions of the Ss when ranked on a continuum. This hypothesis was upheld as shown through the computation of a correlation comparing scores on the discriminating and nondiscriminating items for each S. The Pearson Product-moment Correlation Coefficient resulted in $r = .196$ which was nonsignificant at the .10 level of significance and accounted for only four percent of the variance.

Another factor important in the establishment of the new method was the reliability of that instrument. The Kuder-Richardson (KR20) correlation was .94, confirming the high degree of internal consistency of the instrument.

In conclusion, the new methodology, designed to be used as a measure of FD-FID, filled the need for a reliable, consistent instrument which reduced or eliminated the chances of error which were prevalent in previously designed methods. It would be hoped

that the use of the newly formulated method would reduce the large amount of discrepancy between findings which had characterized those experiments dealing with the relationship between FD-FID modes of perception and other characteristics associated with them.

In line with the above statement, the present method was formulated by the experimenter in order to establish a foundation for examining the relationship between relative social status and the amount of sensitivity to social cues exhibited by members of small natural groups. It seems that the present instrument would allow a more reliable and consistent measurement of sensitivity to social cues (or persuasibility). This improved technique would lead to more accurate conclusions in studies where members of natural groups would be brought into an experimental laboratory situation. If the hypotheses were confirmed that leaders would exhibit scores at the FD end of the continuum and followers or low status members would show scores at the FID end of the continuum, it might be possible to use the rod-and-frame technique as a method for determining potential for leadership among members of various fields where leadership is a highly valued property [law enforcement, the military, businesses, academic institutions].

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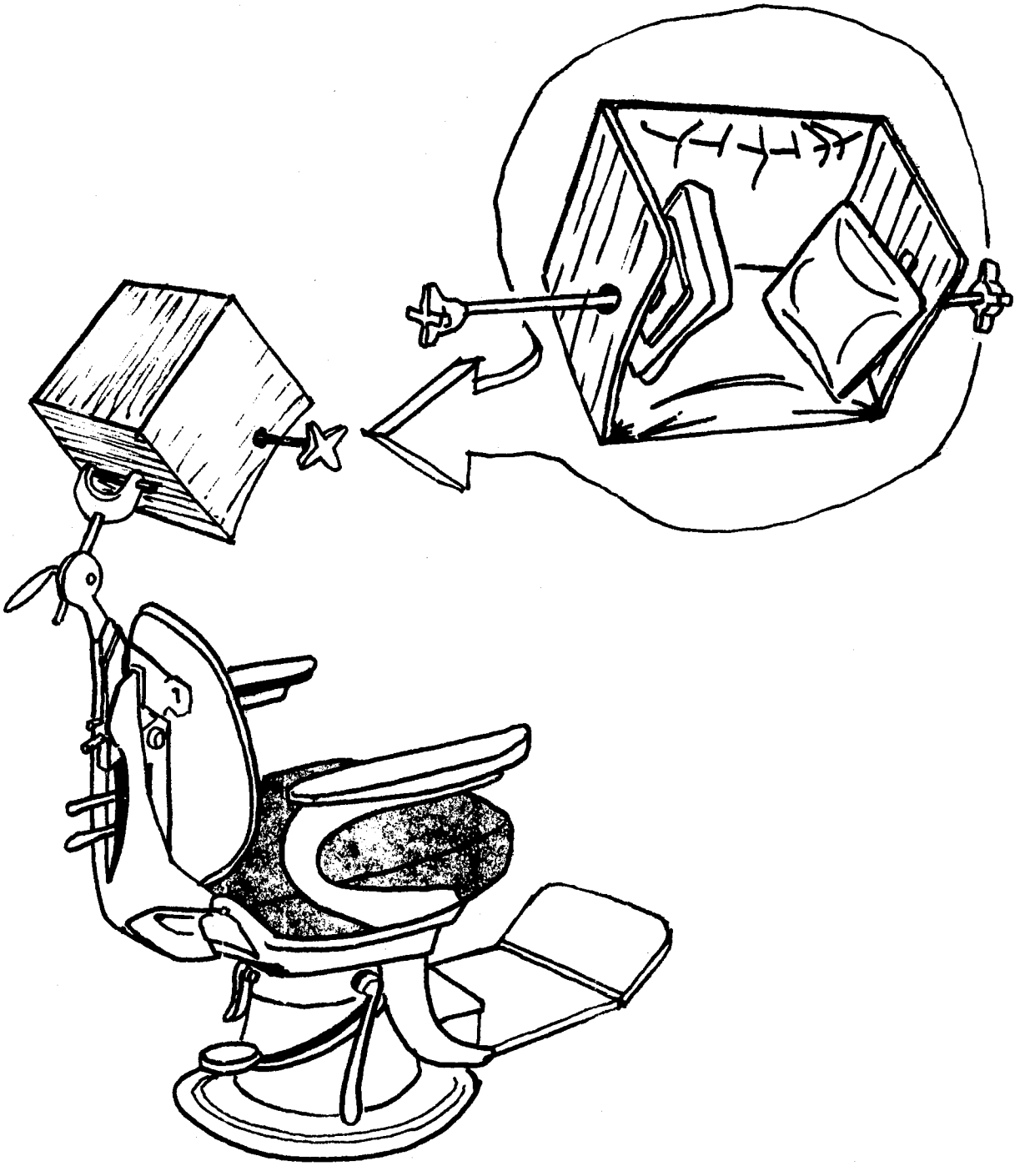
APPENDIX A

Schematic illustration of chair design used in conjunction with the Witkin rod-and-frame apparatus.



APPENDIX B

Composition of Raw Scores
for Each Subject

S#	TOTAL SCORE /Number correct (78 possible)_7	SCORES ON DISCRIMINATING ITEMS /Number correct (60 possible)_7	SCORES ON NON-DISCRIMINATING ITEMS /Number correct (18 possible)_7
1	29	11	18
2	35	18	17
3	47	32	15
4	24	9	15
5	45	28	17
6	27	17	10
7	75	57	18
8	26	9	17
9	28	13	15
10	60	42	18
11	43	30	13
12	47	29	18
13	40	26	14
14	47	32	15
15	28	10	18
16	58	41	17
17	20	2	18

18	47	32	15
19	24	7	17
20	38	22	16
21	33	21	12
22	33	15	18
23	19	1	18
24	38	24	14
25	73	55	18
26	60	43	17
27	33	16	17
28	33	15	18
29	45	28	17
30	28	12	16
31	56	38	18
32	51	28	13
33	22	6	16
34	46	30	16
35	48	31	17
36	33	19	14
37	57	41	16
38	51	34	17
39	33	18	15
40	22	6	16
41	23	7	16
42	48	31	17
43	39	21	18
44	24	10	14

45	49	32	17
46	31	14	17
47	43	32	11
48	41	27	14
49	35	17	18
50	32	17	15

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Master of Science

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