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Field Dependence and Field Independence on a Series of Inverted Field Tasks

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FIELD DEPENDENCE AND FIELD INDEPENDENCE ON A SERIES OF INVERTED FIELD TASKS

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Table of Contents

List of Tables

Studies on distorted vision have long been of major interest to many experimenters. Stratton (1896, 1897a, 1897b, 1899) provided the initial thrust of interest in distorted vision when he did experiments to investigate the theory that inversion of the retinal image is necessary to see things in an upright position.

In his first experiment, Stratton (1896) maintained that if inversion of the retinal image is absolutely necessary for upright vision, as both the projection theory and eye movement theory hold, it is certainly difficult to understand how the scene as a whole could even temporarily have appeared upright when the retinal image was not inverted. The only resistance to seeing things upright seemed to Stratton to consist solely in the resistance offered by the long established previous experience.

In his second experiment, Stratton (1897a) became more detailed in his analysis. He stated, "As long as the new localization of my body was vivid, the general experience was harmonious, and everything was right-side-up. But when an involuntary lapse into older memory materials, or a willful recall into these older forms, ... I seemed to be viewing the scene from an inverted body. (p. 469)."

Upon removal of the goggles, Stratton reported a strange feeling which lasted for several hours. However, he said it did not make things appear inverted. Stratton maintained that the harmony between touch and sight does not

depend on inversion of the retinal image. This is in total disagreement with the projection theory which states that "...objects are projected back into space in the directions in which the rays of light fall upon the retina... and the crossing of those lines of direction requires that if the object is to be projected right side up, the retinal image must be inverted (1896, p. 611)." This disagreement prompted several other authors to find out for themselves how adaptation to distorted vision occurs.

Ewert (1936) offered that complete adaptation to inverted vision is highly improbable. However, he also said that adaptation could take place, because during lapses of attention from the phenomenon, the illusion of reinversion increases as the novelty of inversion wears off.

Ewert (1937) said that adaptation will involve a coordination of behavior guided by inverted vision with behavior guided by unaltered sense data, and until all senses worked together in the inverted atmosphere, total adaptation is impossible.

Brown (1928) concluded from his experiments on distorted vision that disorientation of binocular field vision decreases the ability to perceive immediate depth as judged by perceptual thresholds and by overt performance. He also said that practice with distorted vision did not help restore or greatly improve the ability to perceive depth, but he left it open that with considerable amounts of practice

some improvement can be expected.

Other authors maintain that adaptation to distorted vision is possible. Wooster (1923) and Hardt, Held and Steinbeck (1971) believe that adaptation is the result of a sensorimotor change. That is, new spatial coordinations were formed under conditions of their experiments and were retained for long periods of time, thus leading them to believe that the learning process involved in the acquisition of new bodily habits is of a sensorimotor character.

Weiner (1955) attempted to teach subjects how to effectively utilize postural experiences in the perception of the upright. Using an experimental group of 25 subjects and a control group of 20 subjects, a series of pretests were given to all subjects. The first pretest placed the subject in a tilted position, while a luminous cube in a completely darkened room was adjusted to true upright. The second pretest was the same task with the subject in an upright position. In the third pretest the subject was tilted, and a luminous rod was surrounded by this luminous cube and adjusted to true upright. Subsequently, the experimental group was given one hour of specialized training in space orientation, employing different positions of body tilt and emphasizing bodily cues. Both groups were then retested on the same original tests. The results showed that the experimental group improved significantly in the cube test with the body tilted. The control group also improved, but the improvement was not

significant. The training procedure also led to significant improvement in the rod-in-cube test for the experimental group, while no significant improvement occured with the control group. Therefore, Weiner concluded that adaptation to distorted vision is the result of a proprioreceptive change in the felt position of the body relative to the distorted visual field.

Harris (1963) was interested in how one person was better able to adapt to distorted vision than another. Using wedged prisms, he found rapid adaptation to distorted vision must involve a change in the felt position of the arm relative to the body. When proprioreception and vision give conflicting information, vision gives way, thus making adaptation primarily a proprioreceptive change.

Asch and Witkin (1948a) studied the effects of vision and posture in adaptation to distorted vision. In order to seperate visual and postural factors in their first experiment, Asch and Witkin employed the mirror technique which was first employed by Wertheimer. By requiring subjects to look into a tilted mirror scene while their bodies remained erect, Asch and Witkin presented a situation where the visual coordinates are displaced while the postural position remained unchanged. Using forty-nine subjects, the experimenters attempted to find out whether the perceived upright is based mainly on the axis of the visual field or on position of the body. They found that vision was primarily responsible for

the perception of the upright, and postural effects were secondary.

In their second experiment, composed of three conditions, Asch and Witkin (1948b) put their subjects in a small tilted room and asked them to adjust a rod to true upright. In condition A, the subject viewed the tilted scene from a distance through a tube, which of course limited his view to just the interior of the tilted room. In condition B the subject stood directly in front of the tilted scene without the tube. In condition C, the subject stood at a distance from the tilted scene without the tube, so he saw the tilted scene as well as the outer upright room.

The results showed that condition C proved to have the smallest effect on determining the true upright; that is, in viewing the tilted room with the surround visible, the subject experienced little trouble in setting the rod to the true upright. Condition A proved to be more difficult than both condition B and C. With only the tilted room as background for adjusting the rod to the true upright, the subjects had a more difficult time in perceiving the true upright. Condition B proved to be more difficult than condition C but less difficult than condition A, which was expected.

Witkin and Asch (1948a) in their third experiment of this series, investigated the effects of having a complete absence of a visual field in an upright room. They had subjects move an illuminated rod to what they perceived as being

the true upright in a totally darkened room. Judgments were found to be quite accurate in a dark room, but errors increased when the head or body were tilted. With a small degree of tilt, the rod tended to be displaced opposite to the body, which is called the E phenomenon, and with larger tilts, subjects tended to displace the rod toward the body, which is called the Aubert phenomenon.

Hay and Pick (1966) and Cohen (1967) have also investigated how adaptation occurs, and have found that vision and proprioreception were responsible for any adaptation which occurred, but failed to find one superior to the other.

Van Lear (1968) stated that adaptation is not only possible, but that transfer of adaptation from one motor task to another motor task can occur. In addition, limited aftereffects can be produced by this procedure. Adaptation on the transfer task was not complete, but this coincides with Coren (1966) who showed that complete adaptation is not achieved with subjects who receive only limited feedback.

Several other authors (Peterson, 1926; Peterson and Peterson, 1938; Witkin and Asch, 1948b; Snyder and Pronko, 1952; Pick and Hay, 1964; Harris, 1965; Ebenholtz, 1966; Sekuler and Bauer, 1966; Shaffer and Wallach, 1966; Rock, 1966) have investigated how well a person adapts to the specific conditions of their experiments.

Simple inversion of the retinal image is perhaps one of the most heavily studied areas in distorted vision

experiments. Kottenhoff (1957a) explains the beginning of displaced vision studies and carries them through to his conclusions and theories surrounding the studies. His main conclusion is that "Personal thinking attitudes have a very strong influence on such spatial apprehensions as up or down and left or right (p. 83)." He goes on to say that if a person is to adjust to his inverted world, he must be progressive in his thinking and forget as much as possible the old location of objects in the visual field. In order to build a new visu-spatial world, one must first forget the old one.

Kottenhoff states "From the variation of experimental situations in Innsbruck, it becomes clear that the pre-experimental visual world is mostly perceived in a laboratory environment, whereas active participation in an everyday milieu and it's functions (work, play, etc.) seems to decrease the old memory patterns and favors the building of a new visu-spatial world in correspondence to the inverted visual field (pp. 95-96)."

Kottenhoff disputes Ewert's (1937) assumption that total adaptation is impossible. Kottenhoff felt that because Ewert's subjects spent all their experimental time in laboratory surroundings which were familiar to them, they turned toward reflective thinking which in turn inhibited their ability to adapt to their new visu-spatial world. Kottenhoff maintained that if they were allowed to explore a new environment with unfamiliar surroundings, their thinking

would have been progressive and they would have adapted to their visu-spatial world.

In his second experiment, Kottenhoff (1957b) dealt with a series of tasks with inverted vision and it's effects on introverts and extroverts. His results showed that an introverted person will increase or keep constant his initial illusion of visual field motion, whereas extroverts decrease the amount of illusion (adapt better) in an inversion period of approximately three hours. This is in accord with Eysenck's personality theory which states that extroverted people appear to be able to adapt better to new situations which require a fast spatial orientation.

Rhule and Smith (1959a) stated that "...initial and final adjustment to perceptual inversion depends upon the sensory mode and degree of such inversion, upon the component movements in the inverted performance, and the complexity of the task situation. With more complex tasks, both the initial and final effects of inversion are more severe (p. 342)." Their findings were based on their experiments of handwriting through stationary prisms.

In their second experiment, Rhule and Smith (1959b) studied the effects of pretraining in the performance of handwriting tasks during spatial inversion. It was found that pretraining was exceptionally helpful in their performances. It was also found, however, that women did more poorly than men overall.

Smith and Smith (1962) conducted an experiment using a series of "handwriting" experiments using dots, A's and triangles. The experimenters rotated the visual field from normal visual feedback to right-left reversal. In this experiment, it was shown that the majority of the twenty-four subjects had the most difficult time performing during the up-down inversion of the visual field. In summarizing their experiment, Smith and Smith conclude that the neurogeometric theory would predict that "...more severe disturbance from visual inversion than from either reversal or combined inversion-reversal, because inversion disturbs the intinsic relationships of the visual field (p. 183)."

Experiments in distorted vision have touched many areas, one of them being whether field dependent or field independent persons adapt faster and perform better on experiments with distorted vision.

Linton (1955) tested the hypothesis that people have a generalized tendency to accept or reject externalized influence. The results showed that persons who were highly influenced by the field in one perceptual task performed similarly in other perceptual tasks. Perceptual tasks were "...a four part test of ability to determine the upright in space when gravitational and visual cues are put in conflict (p. 506)." Conformity tests were more a function of personal feelings, and the field dependent subjects scored higher on these tests, indicating their behavior was associated more

with a high degree of conformity than field independent subjects. In short, the field dependent subject depended more on the available cues presented, while field independnet subjects responded more independently of the same cues.

Barrett and Thornton (1968a) tested fifty subjects on the Rod and Frame Test to determine field dependence-independence. Their results were correlated with the degree of nausea encountered in flight simulator tests. Their results showed that field independent subjects were more aware of the available cues, that is the apparent movement of various airplane maneuvers, but their body experienced no movement. Because of this confusion of cues, field independent subjects experienced greater amounts of sickness than did field dependent subjects, who experienced no confusion of cues. This supports Linton's (1955) findings that field dependent subjects rely more heavily on the available external cues, thus failing to experience cue confusion. However, Barrett and Thornton stated that "...in a simple laboratory study of the kinesthetic sensitivity where cues were isolated there may be no differences between field dependent and field independent subjects (p. 308)."

Barrett and Thornton (1968b) showed the superiority of field independent persons in reacting to an emergency situation. After testing subjects on the Rod and Frame test, they found which group, field dependent or field independent, reacted more quickly to a dummy thrown into the path of the car simulator they were driving. The results suggested that

field independent subjects were more effective on responding to emergency situations.

In further investigations of which group, field independent or field dependent, performs better on various sorts of visual tasks, Melamed, Wallace, Cohen, and Oakes (1972) tested nineteen undergraduate students on the Rod and Frame test to determine field dependence-independence, and then by using the method of adjustment, had them place a spot of light directly in front of them in an illuminated and then a dark room. This task requires more veridical judgments of the spatial direction "straight ahead" as measured by the positioning of a spot of light in an illuminated room than making the judgments in a dark room. The results indicated that a strong relationship existed between dependence and the magnitude of the correction effect; the smaller the correction effect, the more likely the subject tested field dependent. In other words, field independent subjects showed a significantly greater correction effect (making a more veridical judgment in a dark room) than did field dependent subjects. These results support the hypothesis that subjects showing a weak correction effect are field dependent.

Witkin, Lewis, Hertsman, Machover, Meissner, and Wapner (1954) gave what they believe to be accurate descriptions of field independent and field dependent persons. They say:

> "...field dependent persons tend to be characterized by passivity in dealing with the environment, and by unfamiliarity with and fear of their own impulses, together with poor control over them; by lack of self-esteem; and the possession of

relatively primitive, undifferentiated body image. Independent or analytical perceptual performers, in contrast, tend to be characterized by activity and independence in relation to the environment, by closer communication with and better control over their own impulses; and by relatively high self-esteem and a more differentiated, mature body image (p. 469)."

Perez (1955) as cited in Witkin, et al. (1962) described field dependence-independence in terms of perceptual constancy. People who are more inclined to be "stimulus directed" may be regarded as able to perceive an item independently of the context in which it occurs. People who show a high degree of constancy may be strongly influenced by an item within the context of their perceptual field; they passively accept the surrounding field, making their perception global in nature.

In an attempt to make studies on distorted vision more precise, Smith, Smith, Stanley, and Harley (1956) were the first experimenters to make use of the television camera in displacing the visual image for the purpose of studying subjects' abilities to adjust to and perform tasks under visual displacement. They state:

"Analytic methods of studying perceptual organization and perceptual control of behavior have utilized numerous procedures for altering the visual field with respect to the position of the body and it's parts. Common methods of alteration are those which employ mirrors, prisms, and lenses to reverse, invert, or otherwise distort the visual field. Closed circuit television provides an elaborate but operationally more useful method for the exceptional analysis of the effects of visual rearrangement upon numerous aspects of behavior. Potentially, it offers control of visual feedback of possibly unlimited significance in research on both perception and behavior (p. 197)."

Smith and Smith (1962) later state "...the use of television to displace the visual field has the advantage of eliminating secondary factors that disturb perceptual-motor integration, and also the advantages of speed and accuracy of control of the preliminary experimental variables (p. 168)."

Since several authors (Witkin, et al., 1954; Perez, 1955; Linton, 1955; Wertheim and Mednick, 1958; Goodenough and Karp, 1961; Barrett and Thornton, 1968a, 1968b; Melamed, et al., 1972) have shown that field independent subjects tend to perform better than field dependent subjects on perceptual-motor tasks, this lead the present experimenter to hypothesize that field independent subjects would also perform better than field dependent subjects on a series of inverted perceptual-motor tasks.

Using closed circuit television, the present experimenter used the method employed by Smith and Smith (1962) to invert the visual field while subjects performed perceptual-motor tasks. Subjects were tested on a portable Rod and Frame test to determine if they were field independent or field dependent. After the subjects were found to be field dependent or field independent, they performed a series of perceptual-motor tasks suggested by Fleischman (1958).

The three tasks performed were rotary pursuit, pursuit confusion, and track tracing. For the pursuit rotor task, time-on-target (TOT) was recorded. For the pursuit confusion task, TOT and errors were recorded. For the track tracing task, errors were recorded. These three tasks were chosen as

a representative sample from several tasks because each one loads heavily on seperate factors and are relatively independent of each other. Rotary pursuit loads .50 on Fine Control Sensitivity. Pursuit confusion (TOT) loads .37 on Rate Control and pursuit confusion (errors) loads .36 on Arm-Hand Steadiness. Track tracing loads .50 on Arm-Hand Steadiness (Fleischman, 1958).

Method

Subjects

Ninety-six males presently enrolled at Eastern Illinois University were enlisted as volunteers for use as subjects.

Apparatus

A portable Rod and Frame Test, model V-1260-A, produced by the Polymetric Company was used to test subjects to determine field dependence and field independence. A Sony Video Camera, model AVC-3200 equipped with the Sony TV Zoom Lens, was mounted on it's tripod and extended to it's full height, approximately four feet off the floor. An Apeco Transistor Receiver/Monitor, model TWA-77, was used to reproduce the camera's image.

For two of the tasks, a Layfayette Photoelectric Rotary Pursuit, model 2203E, was employed. Two faces were used on the same apparatus to produce two of the tasks. The circular face was used for the pursuit rotor task. The diameter of the circle was 28.5 centimeters (cm) from the center of light path to light path. The light path was the nonpainted portion of the face which was 1.8 cm in width. (See appendix A, fig. A) The triangular face was used for the pursuit confusion task. The length of each side of the triangle was 21 cm, and the light path was also 1.8 cm wide (See appendix A, fig. B). The final task was a specially constructed track tracing device similar to the one employed by Fleischman (1958). It was an 8 x 10 piece of metal mounted in a picture frame of the same size. Using metal nippers, a track was

cut out of the metal in a pattern similar to the one shown by Fleischman (1958). (See appendix A, fig. C) The stylus was a Bic pen casing with the tip bent approximately to a 45 degree angle. The tip of the stylus was made with small washers on either side of a collar pin and held in place with a nut and bolt. Looking somewhat like a capital "I" from the side, the stylus tip was inserted into the track and negotiated through it.

There is some discrepancy between Fleischman's (1958) track tracing device and the one used in the present experiment. Fleischman's device was more sophisticated in that two trials could be done by following the track from left to right, depressing a plunger which reset the timer and counter, and return back through the track from right to left. In the present experiment, the experimenter had to watch the subjects to see when they had reached the finish box so the timer and counter could be reset. After the data was recorded, the stylus was returned to the left side of the track by the experimenter and inserted into the maze to begin a new trial.

Fleischman's stylus was also more sophisticated than the one used in the present experiment. Due to the placement of the track tracing device in the present experiment, the stylus had to be bent at an angle so the subjects could see the tip. Fleischman's stylus was straight and therefore easier to negotiate through the track.

In order to record data for each subject, a Layfayette stop clock, model 58007, was used to keep time in seconds to hundredths of seconds. Two Hunter Decade Interval Timers, models 100-C and 111-C, were used to control the Photoelectric Rotary Pursuit's intertrial interval and trial interval respectively. A Marietta four digit manual reset counter was also used for all three tasks to record the number of errors. Finally, an 8 x 10 mirror mounted on it's own frame was placed in front of the monitor to get the desired inversion of the image. In order to get just inversion of the image, the monitor had to be turned up-side-down. However, this produced inversion and reversal of the image. Placing the mirror in a position so that the monitor's image was reflected off it and at the same time in a position so the subject could see the image, produced the desired inversion of the visual field. (See appendix A, fig. D)

A wooden stand was constructed to hold all of the apparatus. (See appendix A, fig. E) The track tracing apparatus was fastened to the wooden stand with hinges so it could be swung up out of the way when it was not in use. Also in this manner, when it was in use, it was in the same position of the pursuit rotor and pursuit confusion tasks. In this way, the camera's height remained constant throughout the entire experiment. In order to prevent subjects from seeing the apparatus directly, a bed sheet served as a divider between the subjects and the apparatus. A slit was

cut in the sheet so the subjects could put their arm through the sheet to perform the various tasks.

Procedure

The subjects (Ss) were tested on the Portable Rod and Frame Test (PRFT), as their first experimental task. The PRFT was administered to all Ss by a person other than the present experimenter. This was done to eliminate the possibility of experimenter bias. The Ss final scores on the PRFT were arrived at by taking the mean absolute error for eight trials. Field dependence (FD) and field independence (FI) were determined by employing a median split. Ss whose scores fell above the median were considered FI and Ss whose scores fell below the median were considered FD.

After the Ss had been tested on the PRFT, they were later recalled to perform three motor tasks in an inverted visual field. Six permutations of the three tasks were derived, so each group of six Ss received different task orders. In this way the tasks were counterbalanced to dispell any questions regarding the task order being helpful or detrimental to any one Ss' performance.

Ss were seated in a chair facing the monitor and mirror. When the S was comfortable, he was read some general instructions to give him a general overview of the entire experiment; that is, he was told that he would be performing three motor tasks in an inverted visual field, what the purpose of the sheet was, and that he would be required to use a stylus to perform all three tasks. Just prior to the

beginning of each task, Ss were told what they were required to do for each specific task. (See appendix B for complete instructions).

For each task, the present experimenter would hand the S the stylus and, for the pursuit rotor and pursuit confusion tasks, place the stylus on the lighted target and inform the S that the target would begin moving in ten seconds. The target was set to rotate at thirteen rpm, the lowest possible speed available without the target jerking while rotating. For the track tracing task, the present experimenter showed the stylus to the S and inserted the stylus in the beginning of the track. This was done in an effort to save time and to prevent any undue strain on the S's arm. Approximately thirty seconds were allowed between each trial in which the S was allowed to lower his arm and rest it.

The present experimenter recorded TOT and the number of errors for every trial of the pursuit rotor and pursuit confusion tasks. The mean score of these measures for all five trials served as the S's final score on the particular task. TOT scores were the mean number of seconds that the S had the stylus placed on the lighted target. Every time the stylus fell off the target, an error was recorded. Therefore, the mean error score for five trials reflects the number of times the S was on the target and then fell off. Performance on the track tracing task was also recorded in seconds and errors. The mean number of seconds was recorded

for the time in contact with the top, sides, or bottom of the stylus to the maze for all four trials. Errors were recorded each time the S touched the metal stylus tip to the metal maze. These were also recorded as a mean score for all four trials.

In an effort to eliminate the inconvenience of changing the apparatus around for either left or right handed Ss, all left handed Ss were tested on the final day of testing. In this way the apparatus only had to be moved around one time.

Results

A Pearson Product-Moment Correlation Coefficient between all measures was computed. Table 1 provides the relevent information concerning the intercorrelations among measures of field dependency and the ability to perform accurately on a series of perceptual-motor tasks in an inverted visual field. For purposes of data analysis, only the mean scores for each S's performance were used.

TABLE 1

INTERCORRELATIONS

Variable	2	3	4	5
1. PRFT	-.42*	-.45*	-.43*	-.10
2. Pursuit Rotor (TOT)		.41	.38	-.03
3. Pursuit Confusion (TOT)			.92*	-.07
4. Pursuit Confusion (errors)				-.03
5. Track tracing (errors)				

*$p < .001$

Table 2 shows the means and standard deviations for the five variables which were presented in Table 1. In addition to showing the total mean and standard deviations for all Ss tested, it also shows the means of the FI Ss and the FD Ss. The total mean performances were derived by taking the mean scores of all the Ss for that particular task, adding them up and dividing by N (N=96). For the means of FI and FD Ss,

the same procedure was followed, but the N's were 51 and 45 respectively.

Three scores were tied for the median, and these three scores were put above the median. This made the FI means higher than they would have been had the scores been distributed evenly on both sides of the median. Despite this fact, there is still a large difference on the dependent variables between the FI and FD means.

TABLE 2

MEANS AND STANDARD DEVIATIONS OF EXPERIMENTAL TASKS

Task	FI		FD		Total Ss	
	mean	SD	mean	SD	mean	SD
PRFT	1.27	.59	5.67	3.30	3.33	3.24
Pursuit Rotor (TOT)	1.40	.81	.68	.55	1.06	.79
Pursuit Confusion (TOT)	2.66	1.38	1.27	.88	1.98	1.36
Pursuit Confusion (err)	6.49	2.74	3.91	2.23	5.21	2.80
Track tracing (errors)	62.31	51.92	59.26	46.97	60.78	49.69

All of the relevent variables correlated negatively with the PRFT. That is, the higher the Ss' score on the PRFT (more FD) the poorer the S did in performing all three of the inverted field perceptual-motor tasks. Conversely, the lower the Ss' score on the PRFT (more FI) the better the S performed on the three inverted field perceptual-motor tasks.

Discussion

The results of the present experiment were found to be in accord with previously reported results by several authors (Witkin, et al., 1954; Perez, 1955; Linton, 1955; Wertheim and Mednick, 1958; Goodenough and Karp, 1961; Barrett and Thornton, 1968a, 1968b; Melamed, Wallace, Cohen, and Oakes, 1972); that is, field independent Ss tend to perform better on perceptual-motor tasks. The present results also lend support to the hypothesis that field independent Ss tend to be more effective than field dependent Ss on a series of inverted field perceptual-motor tasks.

The present results suggest that field independent Ss possess more Fine Control Sensitivity on inverted perceptual-motor tasks than field dependent Ss, since the pursuit rotor (TOT) loaded .50 on Fine Control Sensitivity. (Fleischman, 1958). Pursuit confusion (TOT) loaded .37 on Rate Control, again suggesting that field independent Ss perform better than field dependent Ss on inverted perceptual-motor tasks. Since pursuit confusion (errors) loaded .36 on Arm-Hand Steadiness, it could also be assumed that field independent Ss perform better on inverted field perceptual-motor tasks requiring Arm-Hand Steadiness. Track tracing loaded .50 on Arm-Hand Steadiness, but field independent Ss did not perform significantly better on this task than field dependent Ss. Some possible explanations for these results shall be discussed.

Several reasons could be attributed to the nonsignificance of the track tracing task. As was stated earlier, the present experimenter tried to follow Fleischman's (1958) models for the tasks as closely as possible. The lack of time and proper materials prevented exact duplication of Fleischman's original track tracing device. Instead, a modified version of the track tracing maze and stylus were made as close to Fleischman's specifications as possible. Also, the placement of the track tracing maze had to be such that the camera could be placed to present a clear image on the monitor and consequently, the mirror. Trying to keep the stylus from touching any part of the maze was difficult enough under normal vision, but with inversion, it was an insurmountable task. In spite of the fact that the instructions asked Ss to take their time in trying to get from one end of the maze to the other, several Ss went through it as rapidly as they could. One explanation for this could be due to fatigue. It was observed by the present experimenter that when a S took his time in going through the maze, trying not to touch the maze with the stylus, his arm would often times start to shake. This increased the number of errors dramatically. In addition, the stylus tip could not be seen as well by the S through the monitor's image as well as through direct vision, so the S was not able to tell if he was touching the top, sides, or bottom of the stylus to the maze except by feeling it touch. These are some of the

possible explanations for the lack of relationship between field independent Ss and field dependent Ss on the track tracing task.

Elliot (1961) has shown that a correlation of .42 exists between the Rod and Frame Test (RFT) and the Witkin Embedded Figures Test (WEFT). He said "When field dependence is measured by the EFT, it tends to be significantly related with any measure of ability and to share more common variance with quantitative-spatial tests than with verbal tests. When field dependence is measured by the RFT, it tends to have slight negative relationships with ability measures (p. 28)." In addition he states that "Fast performance on the EFT is related positively with high ability.....ability scores are less likely to correlate significantly with the RFT (p. 28)."

Since Elliot feels the EFT is a more significant test to measure quantitative-spatial ability than is the RFT, it would be interesting to obtain results from an experiment similar to the present experiment, only using the EFT instead of the RFT to determine FI and FD. This approach may increase the significance of the present experiments results.

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Appendix A.

Fig. A

Fig. B

Fig. C

Fig. D

Fig. E

Appendix B

The complete instructions given to each S are as follows: "This is an experiment to see how well you can perform an a series of motor tasks in an inverted visual field. You will be required to put your hand through the curtain, and then you will be handed a stylus. You will be told what to do with the stylus just prior to performing the task. The purpose of the curtain is to prevent you from directly seeing your hand and the stylus. The only way you will be able to perform the task is by viewing the image on the mirror in front of you. However, the image will be inverted so you must work carefully in order to perform well."

Pursuit Rotor: "You will be required to keep the stylus on the lighted target while it rotates clockwise in a circle. Five twenty second trials will be presented with a ten second interval between each trial. Remember, try your best to keep the stylus on the lighted target until all five trials are completed. Do you have any questions?"

Pursuit Confusion: "You will be required to keep the stylus on the lighted target while it rotates clockwise in a triangular shape. Five twenty second trials will be presented with a ten second interval between each trial. Remember, try to keep the stylus on the lighted target until all five trials are completed. Do you have any questions?"

Track Tracing: "You will be required to negotiate the stylus through this maze. Your objective is to try to get the stylus from one end of the maze (pointing to the start box) to the other end of the maze (pointing to the finish box), trying not to touch the top, sides, or bottom of the stylus to the maze. Four trials will be presented. There is no time limit, so take your time and try your best not to touch the stylus to the maze. Do you have any questions?"