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MULTIVARIATE RELATIONSHIPS AMONG VISUAL PERCEPTUAL ATTRIBUTES AND GROSS MOTOR TASKS WITH DIFFERENT ENVIRONMENTAL DEMANDS

by

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This descriptive study investigates the underlying factors and interrelationships among five visual perceptual attributes and two performance stages of two gross motor tasks with different spatial/temporal environmental demands. The Spatial Motor Task is a modification of the Scott Motor Ability Obstacle Race (Scott, 1943). The Spatial/temporal Motor Task is a modification of the Crawford Soccer Test Battery (Crawford, 1957). The basic difference in task demands is the moving ball in the latter task. Early and later performance stages are determined by averaging the first three scores on the first day and averaging the best three scores on the second day. The visual perceptual variables, selected on the basis of their role in performance of gross motor tasks as previously reported in research, are Coincidence Anticipation, Field Dependence/independence, Perceptual Speed, Peripheral Range, and Spatial Relations.

Data were collected over a three week period of time during the spring 1977 semester. All assessments are made on a carefully scheduled basis by trained administrators. Eighty randomly selected undergraduate women enrolled in the general college physical education classes serve as subjects.

Findings reveal the visual perceptual attributes are consistent with values and interrelationships included in the literature within the past decade. Both gross motor tasks evidence change of performance with practice through the Cognitive and Associative phases of learning.

Interindividual reliability of the variable measures range between .72 and .99.

Five factors underlying the data space account for 81% of the total variability. Factor I represents the ability to perform the Spatial/temporal Motor Task (ball). Factor II is associated with the ability to extract and relate pertinent environmental information. Factor III encompasses the ability to relate to the total environment while moving through the Spatial Motor Task (nonball). Factor IV represents the ability to anticipate coincidence and Factor V derives largely from the ability to detect peripheral motion. Three low but significant ($p \leq .05$) interfactor correlations are identified: (a) Factor I is inversely related to Factors IV and II, and (b) Factor III is directly related to Factor V.

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CHAPTER I

INTRODUCTION

The acquisition of gross motor skills is explained by numerous theoreticians according to an information processing model (Whiting, 1969). Whiting (1969) suggests perception, translation, and effection as three processes necessary to accomplish a desired task. Specific motor tasks encompass varied complexity of display or environmental information (Gentile, 1975). Whiting (1972) states that experience within the skill learning/performance environment produces discrimination of the pertinent details from the redundant constant information. Connolly (1970) alleges that to accommodate to the environment which is full of information, the learner must establish the existent redundancies and establish contingencies of events. These statements are representative of constructive theory of perception (Haber & Hershenson, 1973).

Constructive models usually describe perception and the recognition of pattern as active processes. In general, constructive theorists propose that the perceiver first forms an abstract representation of the stimulus pattern guided by the organizational properties in the environment. The perceiver then makes hypotheses based on expectations. The hypotheses take into account the rules of similarity, redundancy, and probability which the perceiver has formed in past experience (Haber & Hershenson, 1973).

Fleishman & Hempel (1954) have demonstrated that different perceptual abilities function at different stages during the learning of a complex motor task. Gentile et al. (1975) have found that motor task organization differs as the environmental demands become more complex. One major difference in organization is the amount of preparation time prior to movement. This relates within the information processing model to perception and translation.

If one accepts the premises that (a) gross motor tasks vary in the complexity of the environmental demands, (b) the complexity of the task affects the premotor processing, and (c) the learner of the gross motor task searches for the organizational properties in the environment based on experience, then, questions come to mind about the interrelationships among perceptual attributes and stages of acquisition of selected gross motor tasks with varied spatial/temporal environmental demands.

Statement of the Problem

This investigation seeks an answer to the question: What are the interrelationships of five selected visual perceptual attributes and performance measures representing stages of acquisition of two gross motor tasks with different spatial/temporal environmental demands?

More specifically the following subproblems are studied:

1. What are the relationships between the earlytrial and latertrial performance measures within the spatial and the spatial/temporal motor tasks?

2. What are the relationships among the earlytrial and latertrial performance measures between the spatial and spatial/temporal motor tasks?

3. What are the relationships among field dependence/independence, coincidence anticipation, perceptual speed, peripheral range, and spatial relations?

4. What is the relationship of coincidence anticipation, field dependence/independence, perceptual speed, peripheral range, and spatial relations to the earlytrial and latertrial performance measure of the spatial motor task and the spatial/temporal motor task?

5. What underlying factors are suggested by the multivariate analysis of coincidence anticipation, field dependence/independence, perceptual speed, peripheral range, spatial relations, and the early-trial and latertrial performance measures of both the spatial and spatial/temporal motor tasks?

Definition of Terms

The following are terms defined as they are used in this study.

Ability--a general trait, fairly enduring in adults, inferred from consistencies of response on certain kinds of tasks. Abilities are used when attempting to learn a new task (Fleishman, 1967).

Coincidence Anticipation--the average corrected score to the nearest .001 second across 36 trials of responding to the Bassin Anticipation Timer at 3 speeds from both left and right. This involves the perceptual matching of a movement with the tracking of position and time of a moving object.

Common Factor--one which contains two or more factor loadings of .500 or above.

Earlytrial Performance Stage--the mean of scores on the gross motor tasks for trials 1, 2, and 3 to the nearest .01 second.

Environmental Demands--the constraints of the display and surroundings that must be matched by movements in order to attain the established objective of the task (Gentile, 1975).

Feedback--knowledge of results.

Field Dependence/independence--the average absolute value in degrees of errors from the vertical across 21 trials obtained from the Rod-and-Frame Test. This represents a continuum of cognitive style involving an individual's orientation to the total environment or to specific aspects of the environment and the relationship of that orientation to the self.

Gross Motor Task--a purposeful movement of the total body through environmental space.

Information Processing Model--a graphic representation of a systems analysis obtained by abstracting similar processes from total acts of communication and categorizing the processes as components in a system.

Latertrial Performance Stage--the mean of the best 3 of the last 6 trial scores of the gross motor tasks to the nearest .01 second.

Perceptual Speed--the average of absolute scores over the 12 subparts of the Embedded Figures Test--Form A, representing the speed of selecting relevant cues from an environmental display.

Peripheral Range--the average of scores to .01 degree across 12 trials measured with the Keystone Periometer, i.e., the ability to detect motion in the visual periphery.

Spatial Motor Task--movement of the total body through a stationary environment.

Spatial/temporal Motor Task--movement of the total body through an environment which has stationary and/or motion attributes.

Spatial Relations--the number of correct responses on Form T of the Differential Aptitude Subtest Space Relations (Bennet et al., 1973). This represents the ability to recognize the interrelationship of specific aspects of an environmental display and to mentally manipulate those aspects and recognize the resultant new interrelationships.

Unique Factor--one which contains only one factor loading of .500 or above.

Visual Perception--the central neural mechanism functions of processing, organizing, and interpreting of visual sensory receptor messages sent to the brain via neural impulses (Whiting, 1969).

Assumptions Underlying the Research

The following assumptions are made in reference to this study:

1. The Rod-and-Frame Test is a valid measure of Field Dependence/independence.

2. When error scores are added to a constant in order to account for the direction of the error, the average corrected score across trials is a valid measure of Coincidence Anticipation.

3. Form A of the Embedded Figures Test (EFT-A) is a valid and reliable measure of Perceptual Speed.

4. An average score across trials using the Keystone Periometer is a valid measure of Peripheral Range.

5. Subtest Space Relations of the Differential Aptitude Test (DAT) provides a valid and reliable measure of Spatial Relations.

6. Average time to the nearest hundredth of a second across 3 trials is a valid measure of performance of the motor tasks.

Scope of the Study

The time period encompassing the collection of the data is March 21 through April 8, 1977. Subjects for the study are 80 undergraduate women randomly selected from students enrolled in the general college physical education classes at the University of North Carolina at Greensboro spring semester 1977. All subjects are less than 25 years of age, have little or no soccer experience, and consent to participate prior to the study. Subjects have no physical limitations restricting participation in the study as affirmed by the University of North Carolina at Greensboro Health Service Ratings.

Visual acuity is not controlled except to require people who wear corrective lenses to use them in their normal pattern. The only control made on prior experiences of the subjects is with regard to soccer participation. Because of the specific demands of the spatial/temporal task used in the study, experienced soccer players are excluded.

Significance of the Study

One of the most consistent findings of experimental research is the variability which exists among subjects in skill acquisition--the individual differences. Very often these individual differences alone account for more of the variability of performance than any other factor(s) which are operating (Whiting, 1969). Whiting (1969) makes a plea for closer investigation and consideration of these variations existing between and within populations. Alderson (1972) supports this, indicating that theories of motion perception imply central nervous system processes for the perception and prediction of motion which are not task-specific, but rather task-oriented. As such these processes can be said to be individual difference variables of the type studied by Fleishman and his coworkers over the past twenty years. One can only conclude that abilities are important variables in motion perception and prediction (Alderson, 1972).

Vision has been shown to be the dominant perceptual mode in most perceptual studies using either conflict or natural settings (Klein, 1976) and the primary determiner of movement accuracy (Kelso & Stelmach, 1976). Klein (1976) reports an unpublished study designed to determine whether visual dominance occurred and whether the bias was the result of selective attention or neural structuring. Results support visual dominance in a motor task and demonstrate that the bias is the result of selective attention.

Physical educators often refer to the complexity of the task based on the complexity of the environment in which the task occurs. Authorities in the field conceptualize the nature of motor tasks as related to environmental constraints, e.g. Poulton, Gentile, and Whiting to name a few.

This study examines (a) abilities used in motor skill acquisition, (b) the dominance of the visual perceptual mode, and (c) the relative importance of visual perception in the performance of spatial and spatial/temporal tasks. The results have implications for increasing knowledge of the interrelationship of these selected visual perceptual attributes. The results may also contribute to the understanding of early stages of acquisition of spatial and spatial/temporal tasks. Findings may be related to the teaching of skills with different spatial/temporal demands. Finally, the results may provide a basis for future research in which visual perceptual variables are operationally defined during the performance of spatial or spatial/ temporal tasks.

CHAPTER II

REVIEW OF LITERATURE

There is extensive literature about visual perception, per se, and visual perception as it relates to motor tasks. The following text focuses only on studies involving adults and the specific visual perceptual variables which are investigated in this study. To the extent possible, research involving visual perceptual attributes and gross motor tasks are included.

Review of the literature concerning the interrelationships of Coincidence Anticipation, Field Dependence/independence, Perceptual Speed, Peripheral Range, Spatial Relations, and Gross Motor Tasks derives from works published in the decade preceding the present study, from 1967 to 1977, and classical selections published prior to 1967. Only salient findings of studies are included in the following discussion.

The chapter is organized in four major sections: (a) interrelationships among the five selected visual perceptual attributes, (b) interrelationships among the five selected visual perceptual attributes and motor tasks, (c) selected analytic models related to perception and motor tasks, and (d) summary.

Visual Perceptual Attributes

Spatial and temporal relationships within the environmental display are obtained primarily via the visual modality (Higgins, 1972). Selective visual attention is the focusing of attention on certain aspects of the environmental display (Whiting, 1969). Based on the limitations of the sense organs, the amount of information present in the display, and the variability of information to be obtained with an optimum level of speed and accuracy, attention must of necessity be selective (Whiting, 1969). Both J. Gibson (1966) and E. Gibson (1969) indicate that visual perception is the active search for distinctive features in the environment. The individual functions as an information processing system that develops strategies for obtaining and using the information in the environment (Connolly, 1969). The following studies concern interrelationships among visual perceptual attributes used to obtain information from the environment.

Field Dependence/independence as measured by the Rod-and-Frame Test is a dimension of cognitive style interrelating information about the individual him/herself and the visual environmental display. The relatively field independent individual is likely to restructure the environmental display. Cognitive style encompasses both visual perceptual and intellectual functions (Witkin et al., 1977).

The Embedded Figures Test is also a measure of a dimension of cognitive style (Witkin et al., 1971). However, the EFT involves the speed with which an individual can perceptually disembed a simple figure from a complex design (Witkin et al., 1971 and 1977). Witkin et al. (1971) suggest there is a high relationship between the Rod-and-Frame Test and the Embedded Figures Test. Evidence to support this idea is questionable.

Arbuthnot (1972) reports two studies using 48 and 143 adult females with correlations of the Rod-and-Frame Test and Embedded Figures Test of

.38 and .56 respectively. Both correlations are significant at the .01 level. Arbuthnot (1972) suggests that because the two tests have low common variance (14% to 31%) they should both be used in studies seeking to answer this aspect of cognitive style.

Lasry & Dyne (1974) compare two studies with 22 men and women and 17 men and women. Means and standard deviations for the Embedded Figures Test reported for the adult females are M = 81.45 seconds, s = 23.54; M = 59.96 seconds, s = 24.46; for the adult males are M = 37.71 seconds, s = 22.58; and M = 44.41 seconds, s = 21.50. For the Rod-and-Frame Test the respective group means and standard deviations are M = 6.46^{o}, s = 3.19 and M = 1.82^{o}, s = .61 for adult females; and M = 3.26^{o}, s = 2.08 and M = 2.02^{o}, s = 1.06 for the adult males. Lasry & Dyne (1974) state that the low and varied correlational patterns imply that the Embedded Figures Test and Rod-and-Frame Test tap different dimensions of cognitive style, especially between the genders.

In two studies with college age females, Witkin et al. (1971) report means and standard deviations for the Embedded Figures Test. With a sample size of 51 the reported average group score is 66.9 seconds with standard deviation of 33.6. The reported average score is 69.4 seconds with standard deviation of 41.0 for a sample of 34.

The Differential Aptitude Subtest Space Relations involves the mental manipulation of a two dimensional figure into a three dimensional figure. Speed and accuracy are both factors for successful completion of the task in a 20 minute time limit (Bennett et al., 1973). Bennett et al. (1973) report the means and standard deviations for

Differential Aptitude Subtest Space Relations. With a sample of 244 twelfth grade girls, the average number correct on Form T was 30.8 with a standard deviation of 12.4. In a second study with a sample of 95 twelfth grade girls the average score was 52.9 correct on Form A with a standard deviation of 10.1 (Bennett, 1973).

Twenty-five female and 25 male undergraduate students are given the Rod-and-Frame Test, Group Embedded Figures Test, Differential Aptitudes Space Relations Test, and the Draw-a-Person Test (Sherman, 1974). The Rod-and-Frame Test based upon sum of absolute errors for eight trials provided 7.98° and 5.33° as the group means for females and males respectively. The average scores reported for the Group Embedded Figures are 12.44 for females, and 13.72 for males. Females average 54.40 correct on the Differential Aptitudes Space Relations Test, Form A, and males averaged 67.52 correct. The Draw-a-Person Test provides averages of 23.64 points for females and 20.56 points for the males. Significant correlations with $p \leq .05$ are obtained for females as follows: (a) between Rod-and-Frame Test and Group Embedded Figures Test ($r = -.60$), (b) between the Space Relations Test and Group Embedded Figures Test ($r = .79$), and (c) between the Rod-and-Frame Test and the Space Relations Test ($r = -.62$). Significant correlations with $p \leq .05$ are obtained from the men's scores between (a) Group Embedded Figures Test and Space Relations Test ($r = .62$), (b) Rod-and-Frame Test and Space Relations Test ($r = -.43$), and (c) Space Relations Test and Draw-a-Person Test ($r = -.34$). The conclusions of this study are that field dependence/independence is related to space relations and that there are significant gender differences only on the Space Relations Test (Sherman, 1974).

Bergman & Engelbrektson (1973) have factor analyzed test results obtained from 93 college men on several Rod-and-Frame Test Scores, Embedded Figures Test Scores, and two spatial relations test scores. Correlations of the Embedded Figures Test with each of the Rod-and-Frame Test scores are .23, .20, and .40. The Embedded Figures Test and both spatial relations tests are loaded on the first factor extracted. The second factor relates to the Rod-and-Frame Test (Bergman & Engelbrektson, 1973).

Perception of motion is generally described as: (a) motion of objects and (b) movement of the observer (Gibson, 1954, 1966, 1968). Motion of objects is manifested by speed and direction and can be abstracted from the object (Gibson, 1954). Perception of objective motion is not simply motion in the retinal image (Gibson, 1954). The distinction of perceiving objective motion, detecting subjective movement, and realizing their potential interaction is determined by central nervous system functions interrelating visual perception and proprioception (Gibson, 1966 and 1968). Perceived objective motion is tied to the interrelationships among perceived surfaces in the field of view and subjective proprioception (Gibson, 1954, 1966, and 1968).

The prediction of reappearance of a moving object is hypothesized to involve some kind of estimation of space, velocity, and time. Bonnet & Kolehmainen (1969) found that prediction depends on the relative ease of utilization of cues about space, velocity, and time when all are available in a given situation. They propose that no general rule should be applied to all situations. The parameter (space, velocity, and time) which carries the most importance in a given situation is determined by the ease with which the relevant information can be extracted from that parameter, relative to the other two (Bonnett & Kolehmainen, 1969).

Matsuda (1974) has determined that there are cue selection differences in adults and children (grades 1 & 4) for estimating duration when stimuli are moving or static. When objects are moving, adults relate to velocity, a spatial/temporal phenomenon, as the attentional cue in estimating duration. When stimuli are static, both adults and children are affected by distance between the stimuli in determining duration of presentation.

Ehri & Muzio (1974) determined that cognitive style affects solutions to a problem involving motion in the environment. Sixty-one college students are classified as field dependent, middle, or field independent by their scores on a figure disembedding test with no time limit. More field independent subjects solved the problem correctly than did field dependent subjects. Field independent individuals are able to analyze the stimulus contents, extract the relevant variables, and coordinate them appropriately. Field dependent individuals are dominated by the perceptible physical properties of the total stimulus configuration and are most resistant to suggestions to use other lines of reasoning (Ehri & Muzio, 1974).

Visual Perceptual Attributes and Motor Tasks

The skill of monitoring motion, predicting pathways, and relating to the environment within a movement/motion context constitutes complex perceptual motor behavior. This type of task calls for perceptual analysis, central decision making, and motor response. Another explanation of the same behavior is monitoring, predicting, and relating. The motor response is highly dependent upon the quality of the perceptual phase and subsequent decision/prediction (Alderson, 1972).

There is little argument among investigators that visual perception is related to performance of motor tasks (Jones, 1972). In gross motor tasks the performer is dependent on the visual system to attain cues concerning the condition(s) of the environment (Sanderson, 1972). Because the success of movement is highly dependent upon the quality of movement and the subsequent decisions, research is needed on these two phases. The motor response should also be measured to determine the quality of response as well as perception/decision (Alderson, 1972). The multiplicity of environmental variables which potentially interact in different task situations make suspect any precise theory concerning a specific visual ability and all activities. It follows that the use of visual abilities in activities can best be evaluated by testing a series of factors judged to be relevant in the gross motor context (Sanderson, 1972).

Abilities as defined by Fleishman (1967) are covert processes which underlie skilled motor responses. Abilities derive from differential psychology and are composed of associated/correlated response measures from several skill situations (Alderson, 1972). Fleishman & Rich (1963) suggest abilities are capacities for utilizing different kinds of information. Alderson (1972) suggests that visual/ perceptual abilities which match Whiting's (1969) information processing model of perceptual motor performance include visual acuity, spatial visualization, perceptual speed, and spatial orientation.

Alderson (1972) identifies three main categories of variables which affect the perception and prediction of motion. First, Task Variables are characterized as machine centered, task specific, and arise from research in experimental psychology. Second, Procedural Variables are performer centered, generalized to learning all perceptual motor skills, and arise from skill acquisition studies in experimental psychology. And third, Individual Difference Variables are abilities, and are neither exclusively performer nor machine centered; but the upper limits are probably set by the performer as they are part of the information processing mechanisms (Alderson, 1972).

Considering the cross section of motor tasks, it is inferred that the perceptual aspects necessary for the performance of the task may vary (Jones, 1972). The selective attention to environmental factors is important in each motor task and encompasses three main considerations: (a) the individual's ability to select the most useful sources of information and ability to scan the display and pick out relevant cues, (b) the amount of information in the display, and (c) the time available to search for relevant cues (Jones, 1972). In the performance of motor tasks there may be a conflict between attending to the visual or the kinesthetic modality. When a conflict exists adults tend to direct attention toward visual perception and recalibrate kinesthesis (Klein, 1976). Klein (1976) presents two explanations for the visual dominance: (a) many movements in motor tasks are based on visual information, and (b) the strategy is developed to overcome the inferiority of visual inputs to attract attention. Kelso and Stelmach (1976) state that vision appears to be the dominant modality and primary determiner of movement accuracy.

Following are reviews of studies concerning the selected visual perceptual attributes investigated in the present study and performance of motor tasks. Most studies are descriptive in nature, some using sport or perceptual categories and others using performance stages and perceptual abilities. The majority of information is related to Witkin's dimensions of cognitive style.

Field Dependence/independence and Motor Tasks

Souder (1972) suggests there is a relationship between Field Dependence/independence and accuracy of a postural tracking task. Subjects are selected from a study involving over 200 college women on the basis of their score on the Rod-and-Frame Test. Field dependent subjects average absolute error scores range from 17.8° to 35.1°. Field independence is defined as an average absolute error score of 6° or less. Field independent subjects have significantly better ($p \leq .01$) accuracy in postural tracking of spatial/temporal sensory input patterns and more accurate movement performance. The field independent performers in Souder's study display the following characteristics in tracking performance: (a) they predicted the regularities of input signals, and (b) their perceptual anticipation was higher (Souder, 1972).

Forty-four former Naval aviators selected on the basis of scores on the Rod-and-Frame Test are determined to be Body oriented (field independent) or Frame oriented (field dependent). All subjects perform a complex compensatory task that requires positioning of the body or other reference to the vertical (Benfari & Vitali, 1965). Benfari & Vitali (1965) conclude that the type of orientation is related to the ability to perform the compensatory tracking task accurately. The Body oriented subjects perform the compensatory task with fewer errors. Both groups perform better with kinetic cuing added. However, removal of kinetic cuing results in greater error changes in performance of the Frame oriented subjects (Benfari & Vitali, 1965).

To determine if field independent individuals act on the environment more than field dependent individuals, five active and five inactive males, five active and five inactive females are tested with the Rod-and-Frame by Svinicki et al. (1974). They conclude that there is a significant difference ($p < .01$) in Rod-and-Frame performance between active and inactive individuals. Active individuals are more field independent. There is no significant sex or interaction difference with $p \leq .05$.

Barrell & Trippe (1975) seek to determine if there is a difference in field dependence/independence among individuals with differing levels of skill in various types of sport and dance. Professional and highly skilled amateur adult males from soccer, cricket, tennis, track and field, and dance are tested on the Rod-and-Frame. The tennis pros are more field dependent (M = 3.42) than any other sportsmen (M = 1.63-2.68) and than the amateur tennis players (M = 1.95). There are no other differences among levels within activities. Conclusions are that (a) dancers are not different from sportsmen or nonsportsmen, and (b) team sportsmen are not more field dependent than individual sportsmen (Barrell & Trippe, 1975).

Perceptual Speed and Motor Tasks

Perceptual speed encompasses studies relating speed of disembedding simple from complex figures and some aspect of motor performance. All of the studies that are reviewed assessed field dependence/independence using a measure which also encompasses speed of disembedding as explained in Chapter II, p. 10.

Fifty-one team sportsmen from college teams of baseball, football, and hockey and 64 individual sportsmen from gymnastics, track, swimming, and wrestling are administered the Group Hidden Figures Test (Pargman et al., 1974). The sample is controlled for overlap of activities. Two conclusions are drawn: (a) there is no significant difference in Hidden Figures Test scores between contact and noncontact sportsmen, and (b) the football players have significantly ($p < .01$) lower scores than individual sportsmen. Football players are less accurate/slower at disembedding than are individual sportsmen.

In 1975 Pargman extended the study of disembedding performance and sport type to include both sex and race of college athletes. Male participants include: (a) team sportsmen--25 basketball, 28 baseball, and 37 football players; and (b) individual sportsmen--11 golfers, 30 swimmers, 11 tennis players, and 44 track and field athletes. Female participants include: (a) team sportswomen--eight basketball and eight softball players; (b) individual sportswomen--five golfers, 10 swimmers, 17 tennis players, and 10 track and field athletes; and (c) seven multisport participants. Three conclusions are formulated: (a) male team sportsmen had significantly lower scores ($p \leq .001$) on the Group Hidden Figures Test than did male individual sportsmen, (b) females scored significantly higher ($p \leq .001$) than did males of each analogous sport group, (c) white male athletes scored significantly higher than black male athletes with $p \leq .001$ (Pargman, 1975).

Pargman et al. (1975) evaluate the relationship of the Group Hidden Figures Test with field goal shooting and free throw shooting of 9 female and 10 male varsity basketball players. The researchers conclude that disembedding a static visual field is not a variable of concern in the understanding of dynamic and visual properties which underlie basketball shooting (Pargman et al., 1975).

Williams (1975) determined there is no relationship between fencing classification and disembedding speed/accuracy. Twenty-five fencers classified by the Amateur Fencer's League system are categorized as follows: 14 Classified and 11 Unclassified. Members of both categories are approximately equal in age, education, and number of years of competition. No significant difference between fencing classifications is found on the Group Hidden Figures Test (Williams, 1975).

In a study comparing task performance with displaced vision and performance on the Group Hidden Figures Test, 26 male athletes are selected from swimming, basketball, volleyball, gymnastics, golf, and track and field (Pargman & Inomata, 1976). Subjects are categorized as field dependent or field independent based on their score on the Group Hidden Figures Test. Then they perform a ball throwing accuracy task while wearing left/right reversal lenses. Field independent subjects score significantly higher than field dependent subjects, $p \leq .01$. Pargman & Inomata (1976) conclude there may be common variability of perceptual/cognitive mechanisms and control systems of psychomotor performance.

Pargman & Ward (1976) conclude that athletes scoring higher on the Group Hidden Figures Test do act on the environment more than do athletes scoring low on the Group Hidden Figures Test. Twelve women's varsity volleyball players are filmed in the sagittal plane while performing the volleyball serve and are administered the Group Hidden Figures Test. Stepwise regression is performed on 18 variables including physical characteristics and film measures with the disembedding score as the criterion.

<u>Peripheral Range and Motor Tasks</u>

Graybiel et al. (1955) summarize Russian studies which investigate visual parameters and motor skills. Peripheral range is studied by means of occluding central or peripheral vision of athletes during performance. Normal performance is contrasted with performance with vision occluded. Javelin throwers, discus throwers, and hammer throwers evidence shorter and less accurate throws with peripheral vision occluded, but little effect from central occlusion. Slalom skiers demonstrate major difficulties with motor control and major time increases when peripheral vision is occluded. The skiers have difficulty with central vision occluded but much less difficulty than with peripheral vision occluded. Gymnasts have much greater problems with peripheral occlusion than with central occlusion. Figure skaters evidence loss of symmetry of figures, of precision, and of timing, with peripheral occlusion. Peripheral Range is a major information parameter in the performance of the selected motor tasks (Graybiel et al., 1955).

Vertical and horizontal peripheral range of 122 male and female college athletes and nonathletes is measured with a Baush & Lomb periometer. Williams & Thirer (1975) obtained the following results: (a) athletes have greater horizontal and vertical peripheral range than nonathletes, $p = .01$; (b) female athletes have greater horizontal and vertical peripheral range than female nonathletes, $p = .01$; (c) male athletes have greater horizontal and vertical peripheral range than male nonathletes, $p = .01$; (d) female athletes have greater vertical peripheral range than male athletes, $p = .05$; and (e) female nonathletes have greater vertical peripheral range than male nonathletes, $p = .05$.

Coincidence Anticipation and Motor Tasks

When a motor task contains temporal as well as spatial environmental demands, the performer must make predictions about the temporal phenomena. In motor tasks where interception of moving objects is required the necessary prediction ability is referred to as coincidence anticipation (Stadulis, 1972). Prediction ability has also been called "timing" (Schmidt, 1968), "transit reaction time" (Whiting, 1969), and "perceptual anticipation" (Poulton, 1957). Coincidence anticipation implies two types of behavior: (a) moving body part(s) to a designated intercept point to arrive at the same time as the moving object, and (b) initiating the response before the object arrives at the designated point (Stadulis, 1972). Poulton (1957) delineates two components of pursuit tracking: (a) acquisition of a moving target or rapid motion to a stable target, and (b) perceptual matching of the function relating position and time of the moving object. Whiting (1969) states that transit reaction time is a combination of reaction time and movement time previously referred to by Gestalt psychologists as closure. The eyes focus on the ball to a point, but the performer does not actually focus on the object contacting the implement. The prediction of the ball's movement yields closure which produces an illusion of seeing the object touch the implement (Whiting, 1969).

Williams and MacFarlane (1975) report a study concerning the effects of increasing ball velocity on RT, MT, and catching ability. Findings indicate that as ball speed increases, reaction time decreases significantly ($p \leq .05$), but movement time remains relatively unchanged. Catching ability decreases significantly as ball speed increases, $p \leq .05$ (Williams & MacFarlane, 1975).

Grose (1967) investigated coincidence response in three varied fine to gross motor tasks: (a) finger press, (b) arm movement, and

(c) total body movement. Fifty-one male college students perform all three tasks. Three dependent measures include directional accuracy. Individual differences in timing ability are task specific $[r^2 < (1-r^2)]$. There is a significant difference for both directional accuracy and variability of directional accuracy among motor tasks. Greatest accuracy occurs for the total body movement task, then the arm movement task, then the finger press task. Subjects tend to be early rather than late. The following conclusions are drawn: (a) intraindividual differences are greater than interindividual differences, (b) individual differences in RT have little or no relation to coincidence timing ability, and (c) little or no improvement in coincident timing occurs with practice.

Multiple Perceptual Attributes and Motor Tasks

Stallings (1968) reports the results of a study concerning the relationship of visual/spatial orientation, visualization, and perceptual speed with performance during the learning of a two handed speed pass, a balance beam routine, and an underhand free throw. Forty-two college women are categorized as High or Low for each of the three perceptual factors according to their scores on three Educational Testing Service tests. Subjects have two practice sessions on the motor tasks per week for ten weeks with a 2 week break between the sixth and seventh week. The three motor tasks vary in visual/spatial requirements. Spatial Orientation affects performance on the balance beam routine and, during early stages of practice, on the two handed speed pass. There is an increasing need for perceptual speed with increasing proficiency on the balance beam. Visualization is not a factor in any of the selected motor tasks (Stallings, 1968).

Fleishman & Hempel (1954) have measured 18 variables and eight stages of learning a complex coordination task by 197 adult males. Intercorrelations and ten underlying factors are derived using the Thurstone Centroid Factor technique. The ten factors include: (a) complex coordination task--all trials; (b) psychomotor coordination--pursuit rotor and all levels of the task; (c) rate of movement--RT, MT, rotary pursuit, plane control and discriminant RT; (d) spatial relations--discriminant RT, instrument comprehension, complex coordination stage 1, dial and table reading; (e) perceptual speed--visual pursuit, speed of identification, spatial orientation; (f) visualization--pattern comprehension, mechanical principles, decoding, spatial orientation, and dial and table reading; (g) mechanical experience--general mechanics and mechanical principles; (h) numerical facility--numerical operations, dial and table reading; (i) psychomotor speed--speed of marking, and log book accuracy; and (j) residual.

The quantitative pattern of abilities determining differences in quality of performance change with practice. Factors which are primarily involved in early learning (stages 1-4) of the complex coordination task are: (a) psychomotor coordination, (b) spatial relations, (c) visualization, and some aspects of (d) mechanical experience and (e) perceptual speed. Factors with high loadings in later learning (stages 5-8) include: (a) psychomotor coordination, (b) rate of movement, and (c) complex coordination task (Fleishman & Hempel, 1954).

Fleishman & Hempel (1955), replicating the 1954 study, produce similar results with one exception. Two factors from the earlier study, spatial relations and perceptual speed, do not separate but remain a common factor in the second study (Fleishman & Hempel, 1955). Subjects tend to use visual/spatial information in early stages of learning and kinesthetic/proprioceptive cues in later stages of learning (Fleishman & Hempel, 1954 & 1955).

Fleishman & Rich (1963) report an experimental study used to test the hypotheses generated by the Fleishman & Hempel studies (1954, 1955). Forty adult males are tested to determine if there are differences between low and high kinesthetic sensitive groups on a two hand coordination task when visual cues are given early and kinesthetic cues are given later. The results reveal both low and high kinesthetic sensitive groups use spatial/visual information first then kinesthetic cues. However, there is an interaction effect of cuing type and sensitivity preference. The low kinesthetic group responds readily to the visual cues and learn better at first with the learning curve leveling off early. The high kinesthetic sensitive group are slower learning at first with greater achievement at later stages of practice (Fleishman & Rich, 1963). Thus, the earlier hypothesis is supported.

Motor Task Taxonomy

Fleishman calls attention to the need for a learning and performance theory which ascribes a role to task dimensions. The task taxonomy can serve as a tool to increase the ability to interpret or predict some facet of human performance (Fleishman, 1975). He states that it is possible to build up a body of principles about interactions of task characteristics with individual difference requirements through a correlational/experimental approach (Fleishman, 1967). The approach calls for the development of tasks that vary with taxonomic dimensions and the administration of these tasks to subjects who also perform a series of abilities tasks. Relationships among the abilities tasks and scores on the criterion task specify the individual difference parameter and changes in those parameters as a function of task variation (Fleishman, 1975).

Fleishman (1975) presents the following criteria for evaluating task taxonomies. First, operational definitions are critical and should permit nominal scaling and be defined in a measurement system so they can be readily evaluated. Second, taxonomic categories should be mutually exclusive and exhaustive. Third, taxonomic categories should have behavioral implications to allow application. And fourth, the system should have efficiency and utility to promote communication.

Several taxonomies of motor tasks have been presented over the years, i.e., Poulton (1957), Fitts (1965), and Gentile et al. (1975). The latter motor task taxonomy (Gentile et al., 1975) meets the criteria specified by Fleishman (1975) and encompasses aspects and considerations of previous motor task taxonomies. The assumption underlying the development of the motor task taxonomy is that movements must match environmental constraints in order to produce a particular outcome or change in the environment (Gentile et al., 1975). This assumption is supported by many other experts in the field (Higgins, 1972; Robb, 1972; Spaeth, 1972; Welford, 1976; Whiting, 1969, 1972).

A second assumption is that environmental control has an underlying continuum, but only two broad types are identified, closed and open. Initially, closed environmental control included motor tasks in which regulatory environmental conditions were fixed, stable and stationary throughout the execution of the movement. Open environmental control includes motor tasks in which regulatory conditions involve moving objects and/or persons or involve events that change positions in space during the movement (Gentile et al., 1975).

The motor task taxonomy suggested by Gentile et al. (1975) is presented in Figure 1. It encompasses a delineation of environmental control and two aspects of movement requirements. The movement requirements are categorized as total body stability or total body transport and the absence or presence of independent limb transport/ manipulation (Gentile et al., 1975). The specified movement requirement categories coincide with two of the three movement categories designated by K. U. Smith (1966).

Following several dart throwing studies which are concerned with the motor task taxonomy, Gentile et al. (1975) reach the following four general conclusions. First, movement patterning remains constant despite environmental or movement characteristic changes except when the task involves a moving target in which the spatial <u>and</u> temporal characteristics covary over trials. "For all other task conditions, the abstract spatial and temporal features of the movement seemed determined by the task constraints regardless of individual variation in morphology, past experience, or skill level" (Gentile et al., 1975, p. 27). Second, as regulatory conditions are varied, the subjects make

NATURE OF ENVIRONMENTAL CONTROL	NATURE OF MOVEMENTS REQUIRED			
	TOTAL BODY STABILITY		TOTAL BODY TRANSPORT	
	NO LT/M*	LT/M*	NO LT/M*	LT/M*
SPATIAL CONTROL: STATIONARY ENVIRONMENT				
TEMPORAL/SPATIAL CONTROL: MOVING ENVIRONMENT				

Figure 1. Motor Tasks Taxonomy (Based upon environmental and movement requirements (Gentile et al., 1975, p. 12)).

*LT/M = Independent limb transport and manipulation (usually involving or changing the position of objects in space).

all movement adjustments in the duration of the preparatory phase. Third, alteration of the spatial <u>or</u> temporal environmental characteristic is compensated for by redefining one relevant parameter within the gross movement framework following typically observed range effects. And, fourth, data support the original two categories of environmental control conditions with elaboration of the closed parameter. The gross organization of the movement is maintained across task conditions involving not only fixed/stationary but also "fixed/moving, and variable/stationary environments as well as those variable/moving environments in which <u>either</u> spatial <u>or</u> temporal dimension changed across trials" (Gentile et al., 1975, p. 27).

Summary

The literature reviewed reveals a long held interest of considerable magnitude relating to perceptual attributes. The range of studies focuses on a variety of specific variables and a variety of types of subjects. Many different strategies are used to investigate the role of visual perception in motor tasks.

The present study follows Fleishman's correlational approach (1954, 1955, 1967). Fleishman's emphasis (1954, 1955) is from a psychological perspective interrelating many psychological attributes including performance on a complex coordination task. The present study concerns the interrelationships among performance stages of gross motor tasks and specific visual perceptual attributes from a physical education perspective.

CHAPTER III

PROCEDURES

A broad description of the procedures followed in the conduct of this research is (a) designing the study, (b) collecting the data, and (c) analyzing the data. Specific details constituting these activities are described in this chapter. They are presented in the order in which they were executed.

Designing the Study

Designing the study includes (a) identifying and specifying the gross motor tasks, (b) selecting measures of the visual perceptual variables, (c) developing the data collection schedule, (d) training the test administrators, and (e) selecting the sample.

Gross Motor Tasks

A major purpose of this research is to examine adult female performance, with practice, on two gross motor tasks designed to have varied spatial/temporal environmental demands as defined by the model of Gentile et al., (1975). The following criteria are used in the formulation of the gross motor tasks:

1. Information from the environment is necessary during the performance of the task.
    a. Both tasks have similar spatial environmental demands with dissimilar arrangement.

b. Only one task has temporal environmental demands.

c. Movement demands are similar.

2. Speed with control is the specified criterion of accomplishment.

3. Tasks are self initiated.

4. Tasks are serial in nature.

5. Tasks are safe, novel, and challenge the abilities of college women.

6. Minimal equipment and space are needed.

The scores representing Earlytrial and Latertrial Performance for both motor tasks are the mean of the first 3 trials and the mean of the best 3 of the last 6 trials. Interindividual reliability of each task for each day is determined by the odd-even method for each individual for each day of both motor tasks.

The Spatial Motor Task and the Spatial/temporal Motor Task developed for this research are intended to be examples of gross motor tasks which meet the preceding criteria. The gross motor tasks developed for this investigation are as follows.

<u>Spatial Motor Task</u>. This task requires the movement of the total body in as short a time as possible through a fixed setting with only spatial environmental demands. The Spatial Motor Task, deriving from the Scott Motor Ability Test Obstacle Race (Scott, 1943), is designed by the principal investigator to meet the criteria stated above. Movement requirements include running, simultaneous contact of target areas with both feet, clockwise and counterclockwise movement around obstructions, change of direction, and speed of movement. The

environmental display necessitates a floor space of 43 x 13 feet and is marked on the gymnasium floor with 5/8 inch and 2 inch plastic tape. Details concerning schema, environment, and instructions concerning performance are presented in Appendix A, pages 109-112.

Spatial/temporal Motor Task. The gross motor task involving spatial and temporal environmental demands requires movement of the total body in as short a time as possible through a fixed setting while tracking and relating to a moving ball. The Spatial/temporal Motor Task derives from aspects of the Crawford Soccer Test Battery (Crawford, 1957d) and is designed by the principal investigator to meet the criteria stated above. The movement requirements of the task include running, simultaneous contacts of the ball and floor with the feet, clockwise and counter-clockwise movement around obstructions, change of directions, and speed, all while controlling a soccer ball with the feet. The environmental display is marked on the gymnasium floor and wall using 5/8 inch and 2 inch plastic tape as shown in the diagram in Appendix A, pages 113-114. Floor markings include a 48' x 17' area and the wall markings necessitate a 48' x 3' area.

Visual Perceptual Variables

The second major purpose of this research is to examine the interrelationships among selected visual perceptual attributes of adult females. Field Dependence/independence, Coincidence Anticipation, Perceptual Speed, Peripheral Range, and Spatial Relations are selected as perceptual attributes related to processing environmental information. The following are measures of the perceptual variables.

Coincidence Anticipation. Coincidence Anticipation is measured using a Bassin Anticipation Timer. Processing environmental information in the gross motor tasks involves both the left and right sides and varied speeds of motion. As a result of prior exploration of the motor tasks, ball speeds were established from 0 to 4 mph for adult women with this skill level. Thus, in this investigation speeds for the Bassin anticipation trials are 2, 3, and 4 mph to coincide with the motor task experiences and to reach a speed fast enough for the apparent motion of the Bassin timer to be interpreted as real motion. Information concerning the testing environment, instructions, and scoring are presented in Appendix B, pages 123-127.

A random order of presentation of 6 trials consisting of 6 sets of 3 speeds from both left and right sides is predetermined. The presentation order is presented in Appendix B, page 127. This set of 36 trials is presented to each subject in approximately 10 minutes.

Trial scores represent the time to the nearest 0.001 second of the error of the anticipation. A minus is recorded if anticipation is early; a plus if the anticipation is late. A constant of 1.000 is added to each trial score to allow for a totally positive range of anticipation scores to include the direction of the response. Coincidence anticipation is, therefore, the mean of the adjusted trial scores.

Field Dependence/independence. The level of Field Dependence/independence is determined by using a rod-and-frame device. A random order of presentation of rod and frame relations is used for all subjects. See Appendix B, pages 130-131. The 24 trials consist of 3 frame positions of 0^{o}, 28^{o}, and 332^{o} and the corresponding 8 rod positions for each frame position of 90^{o}, 60^{o}, 45^{o}, 30^{o}, 330^{o}, 315^{o}, and 270^{o}. The administration of the task takes approximately 25 minutes including dark adjustment.

The subject is seated in an upright position 16 feet from the rod and frame. The task requires the subject to move a luminous rod to a vertical or up-and-down position. The rod is surrounded by a luminous square frame and is observed in a dark room. Appendix B, page 128-129, provides pictures of the test environment. Trial scores are the error to the nearest degree of the rod position to vertical position. The mean absolute value of the 24 trial scores is used in the study to represent Field Dependence/independence.

Perceptual Speed. The Embedded Figures Test, Form A, (Witkin et al., 1971) is used to assess perceptual speed. The task involves locating simple figures embedded in each of 12 complex figures. All perceptually normal adults are assumed to be able to extract a figure from the background information. The speed with which a person does the extracting is the perceptual speed. Administration of this task ranges from 5 to 40 minutes depending upon the subject's field dependence.

In this study Perceptual Speed is the average of the 12 trial scores to the nearest second. Reliability of this test for college women is 0.79 (Witkin et al., 1971). Details concerning testing environment and instructions are presented in Appendix B, pages 134-136.

Peripheral Range. The extent of Peripheral Range is determined using a periometer. Processing environmental information in the gross motor tasks in this study involves responding to motion on the left and right sides of the body. The range of peripheral detection of motion at speeds of 18 per second or .5 mph falls within the range of ball speeds observable during the motor tasks yet is manually controllable on the periometer. The task requires the subject to indicate when she "sees" a 3 inch vertical target moving on her left or right side at a distance of 18 inches. See Appendix B, 137-138.

A random order of presentation of 12 trials consisting of equal trials from the left and right is predetermined. See Appendix B, page 139. Approximately 5 minutes is allowed for this task. Peripheral Range is the average range represented by the 12 trial scores to the nearest 1/100 of a degree.

Spatial Relations. The level of Spatial Relations is represented by the score on the Space Relations subtest, Form T, of the Differential Aptitude Tests, DAT (Bennett et al., 1973). The task is one of mental manipulation requiring that a solid be mentally created from a flat form. The score for the DAT Space Relations Test is the number correct with a maximum of 60. Test administration takes approximately 25 minutes. This test has reliability of .92 to .95 for 12th grade girls calculated by the odd-even method.

The Data Collection Schedule

Data are collected over a 3 week period by a team of 6 test administrators. The first 2 weeks involve data collection on the perceptual variables. Each subject participates for 1 hour each week. During the third week of testing, data are collected on the two motor tasks within 1 hour of participation on each of 2 alternate days as prearranged.

Visual perception scheduling during the first 2 weeks pairs the DAT and Rod-and-Frame Tests and groups the Bassin timer, Periometer, and Embedded Figures Tests for the following reasons: (a) to provide combined administration times of 50 minutes maximum, (b) to separate the DAT and EFT tests, and (c) to provide simultaneous administration of DAT and RFT to 2 subjects by one administrator in an hour. The presentation of the tests within each pair/group is randomly determined. The schedule includes approximately equal opportunities for taking the DAT-RFT pair first and second, and the same for taking the Bassin-Periometer-EFT first and second. Approximately equal opportunities are provided across days of the week from Monday through Friday and across hours of the day from 8:00 am to 8:00 pm.

The third week of testing includes 1 hour on each of 2 alternative days of participation in the motor tasks by each subject. Each subject is scheduled to perform both gross motor tasks on both days. Order of spatial or spatial/temporal task practice is randomly assigned to subjects with approximately half performing the spatial task first. The order of task practice is maintained for both days for each subject. The schedule provides for testing from 9:00 am through 4:00 pm on Monday and Wednesday, and from 10:00 am through 4:00 pm on Tuesday and Thursday.

Five trained test administrators are scheduled to collect data on the perceptual tasks for 4 blocks of 3 hours each. During the week of motor task performance, each of 5 administrators are scheduled for 4 blocks of 2 hours each. The principal investigator is scheduled for all additional hours.

Training the Test Administrators

Data are collected by a team of 6 test administrators. Test administrators include the principal investigator and 5 trained women doctoral students in physical education at the University of North Carolina at Greensboro.

Test administrators receive instruction in the test administration, perform the actual tests as subjects, and practice administering the perceptual tasks prior to the first two weeks of perceptual testing. The test administrators participate as subjects on each test for the following purposes: (a) to become totally familiar with the content, (b) to experience what the subjects will experience and better understand any questions or problems that may arise, and (c) to provide a final check on directions to subjects for each perceptual test. Test administrators receive copies of (a) Overall Procedures for Perceptual Tasks, (b) Directions for the Rod-and-Frame Test, DAT-Space Relations Test, Embedded Figures Test, Keystone Periometer, and Bassin timer, (c) three score sheets for the RFT-DAT, Bassin-Periometer, and EFT tasks respectively. Instructions and score sheets are presented in Appendix B, pages 120-142.

Following the administration of the visual perceptual tasks and prior to the week of gross motor tasks, the test administrators are also trained to oversee and practice administering the Spatial and Spatial/temporal motor tasks. Each test administrator performs the two motor tasks for the same reasons indicated previously. Test administrators receive copies of Directions for the Spatial Motor Task, Directions for the Spatial/temporal Motor Task, and scoresheets for the two motor tasks. Directions and scoresheets are presented in Appendix A, pages 111-112 and 115-117.

Selecting the Sample

The population of this study is undergraduate women registered in UNC-G general college physical education classes during the spring semester 1977. Women only are selected for the following reasons: (a) because of demonstrated differences of perception between males and females, one sex is used in the study, (b) more females than males participate in the general college physical education program, and (c) adding sex as a two level discrete factor would of necessity double the sample size or cause confusion in data interpretation. The sample size is necessarily large to handle all the continuous variables. An initial sample of 120 women are randomly selected from the target population by a drawing procedure of classes then individuals within classes. Each subject is directly contacted by the principal investigator and is presented with a personal letter which explains (a) purpose of the study, (b) amount of time expected, and (c) request to participate. Attached to the letter is a consent and schedule form. Both forms are presented in Appendix C, pages 144-145. Consent and commitment of each subject are made to the principal investigator at an initial meeting.

Subjects select the 4 testing times for the three week commitment, give their local address and phone number, indicate if they wear glasses or contact lenses, and when they use the corrective lenses. Subjects keep their letter and a copy of their time commitments. The consent form, including the schedule and personal information, is kept by the researcher.

Collection of Data

Of the original 120 individuals contacted, 94 women enrolled in general college physical education classes during the spring semester 1977 actively participated in this study. Data are collected over a 3 week period by a team of 6 test administrators. Collection of data includes (a) administering the 5 visual perceptual tests, and (b) administering the 2 gross motor tasks.

Administration and Scoring of the Visual Perceptual Tests

The 5 visual perceptual tests are administered individually as scheduled to each subject with only the test administrator present. All subjects receive identical instructions. Clarification is provided by the test administrator if the subject has questions.

The testing environment is consistent for all subjects. Two adjacent rooms are used for the tasks one room for the DAT-Space Relations Test and the Embedded Figures Test, and the second room for the Rod-and-Frame Test, Bassin Timer Task, and Periometer Task. Only one test at a time is administered in a given room with the exception of the chance overlap of administration of the EFT. However, each subject/administrator pair has a diagonally opposite corner of the room from the other pair.

No scores, results, or purpose of the perceptual tests are provided to subjects until all testing is completed, including the gross motor testing. Subjects are told that no value judgments are placed on the scores and that tests and test items range from easier to more difficult and there may be items they cannot complete.

During periods when the Rod-and-Frame Test and DAT-Space Relations Test are administered, there is one test administrator and one or two subjects. When two subjects are scheduled one subject is alone in Room A taking the DAT and the other is in Room B with the test administrator taking the RFT. Positions are reversed as both subjects complete their respective tests. The order of tests for subjects is randomly predetermined.

During the periods when the Bassin timer, Periometer, and Embedded Figures Test are scheduled, there is a test administrator for each subject, one or two per period. When two subjects are scheduled, one subject/administrator pair begins in Room A on the EFT while second pair begins in Room B with the Periometer or Bassin timer. The order of tests to subjects is randomly predetermined by the toss of a coin.

Rod-and-Frame Test. The level of Field Dependence/independence is measured using the Rod-and-Frame Device, Model #18-10 of the Marietta Instruments Company. Two 4' x 8' plywood sheets, painted with flat black paint, stand immediately behind the rod and frame device to provide an artifact free background surface. The room has all light blocked out so the only light source is the luminous phosphorescent paint on the 30 inch rod and 32 inch square frame. See photograph, Appendix B, page 128.

The subject is blindfolded before entering the test room; lights are turned off allowing 4 minutes of dark adjustment. The subject is seated in a wooden chair 16 feet from the rod and frame. The remote control switch is fastened to the top of a 3 foot stool placed between the subject's feet, and the subject's preferred hand is placed on the switch. See photograph Appendix B, page 129.

Directions are read to the subject while still blindfolded. One practice trial is given and questions are answered. The task involves the subject being presented with 24 positions of the rod and frame and using the control switch to move the rod until the subject is satisfied that the rod is "vertical or up-and-down". See photograph Appendix B, page 131. The administrator records each trial score as the number of degrees, 0° - 359°, where the subject positions the rod. The score for the test is the mean across 24 trials of the absolute error of each rod position from 0° or vertical.

<u>DAT--Space Relations Test</u>. The level of Spatial Relations is measured by the Space Relations Subtest, Form T, of the Differential Aptitudes Test (Bennett, Seashore & Wesman, 1973). The subject is seated at a desk corresponding to hand preference and given a pencil, scoresheet, and test booklet. After reading the directions and two sample problems, the subject has the opportunity to ask for clarification. The 25 minute time limit is kept on a Mark Time model

#29033-60M-A766, kitchen timer. See Appendix B, page 140 for photograph of testing condition.

The tests are scored by the principal administrator. Scores representing Spatial Relations are the number of correct responses on the DAT-Space Relations Test, Form T.

Bassin Anticipation Timer Task. The level of Coincidence Anticipation is measured using the Bassin Anticipation Timer, Model #50-575 of the Lafayette Instrument Company. The control box and 5' light track are positioned in the middle of 3' x 6' table with 11¼ inches of track extending beyond the table. Two chairs are positioned 3' from each side of the track and centered with the last light on the track. The test administrator is seated at the opposite end of the table and is readily able to see the track, both chairs, and the control box. See Appendix B, page 123.

The subject is seated in the first chair with the light track approaching from the subject's left side. A remote control switch is held by the subject in the preferred hand with the thumb resting lightly on the button.

Directions are read and six practice trials are provided each subject. The practice trials include a sample of each speed of lights to be approaching from the right side. Speed of lights are manipulated from the control box by the test administrator. See Appendix B, page 124.

The task involves anticipating the arrival of the lights at the last bulb and pressing the button exactly as the last bulb lights.

All subjects have 36 trials with a fixed foreperiod of 1.0 second. The test administrator records the error score to the nearest 1/1000 of a second and a plus sign if the response was late or a minus sign if the response was early.

The principal investigator adds a constant 1.000 to each trial score. This creates an adjusted trial score that represents a positive numerical range of the early and late responses. Coincidence Anticipation is represented by the mean of the 36 adjusted trial scores.

Periometer Task. The extent of Peripheral Range is determined using a Periometer attachment to the Keystone Occupational/Driver Vision Telebinocular Model of the Keystone View Company. A 3" x 1/3" white target is attached in a vertical position to the spherical target on the periometer. Flexible vertical adjustment of the periometer allows the instrument to be positioned at forehead height for each individual.

The subject is seated on a chair. The periometer and stand are positioned directly in front of and between the feet of the subject. Peripheral vision of the white target is against a solid neutral colored background positioned equadistant from each side of the subject and target. See photograph of testing condition in Appendix B, page 137.

The objective of this 12 trial task is the subject's verbal notification to the administrator that the target is seen. After positioning the target behind the subject's head and asking if the subject is ready, the test administrator moves the target at a speed of 90^{o} in 5 seconds or .5 mph to the side of the subject's head as prescribed by the trial number.

The test administrator reads the score from the pointer on the protractor, marked in 5^{o} intervals. Trial scores are used in 5^{o} intervals as the last interval passed by the pointer. The score representing Peripheral Range is the mean of the 12 trial scores to the nearest 1/100 of a degree.

Embedded Figures Test. Perceptual Speed is measured by the Embedded Figures Test, Form A (Witkin, Oltman, Raskin & Karp, 1971). Brenet #22 stopwatches of the Lafayette Instrument Company are used to time all trials in this investigation. The subject is seated at a desk directly across from the test administrator and is given a soft tipped stylus for tracing. See photograph in Appendix B, page 134 for testing arrangement.

The trial score for each of the 12 complex figures is the time to the nearest 1/10 of a second. The score representing Perceptual Speed is the average time across 12 trials calculated to the nearest second.

Administration and Scoring of the Gross Motor Tasks

The Spatial Motor Task and the Spatial/temporal Motor Task are administered individually to each subject with the test administrator and one to three other subjects/persons present. Each subject completes a set of 6 trials of each task on two days, for a total of 12 trials on each task. No less than 48 hours nor more than 72 hours elapse between the two sets of trials. Between trials on the same day, 3 minutes of rest are provided.

On the first day of trials immediately before each task, all subjects receive the directions for the respective task and walk through the fixed environmental pattern. Clarification is provided by the test administrator if subjects have questions. On the second day of trials, subjects are asked if they need a review of the respective task, and/or questions are answered by the test administrator.

The physical testing environment is consistent throughout this investigation. The Spatial Motor Task and Spatial/temporal Motor Task are marked close to opposite end walls of a 90' x 140' gymnasium. Both tests are administered simultaneously to separate groups of subjects.

For both tasks, subjects are informed that the objective is to reduce their score but maintain control. Subjects are informed of their score(s) for the respective task prior to starting each successive trial. Subjects are requested not to discuss their scores or strategies with anyone during the entire week of motor task testing.

Two matching models of the Automatic Performance Analyzer, Model #631 of Dekan Timing Devices, are used to measure the performance in all trials of the Spatial and Spatial/temporal Motor Tasks. See photograph in Appendix A, page 118. Each control unit and the two pairs of switch mats are marked and are used for recording performance of the same respective motor task throughout this investigation. The switch mats are attached to Remote Start and Stop on Make Contact outlets of each control unit. For each motor task, the control unit is placed on a table and the table positioned so the test administrator can readily observe the control unit, both switch mats, and the entire fixed environmental setting. See Appendix A, pages 110 and 113 for photograph of testing conditions for each motor task.

Spatial Motor Task. The Spatial Motor Task involves the following procedure. From a standing position behind the starting line the subject initiates the task by stepping on the Dekan timer mat, moves as quickly as possible to the 3 successive rectangles placing both feet inside each target, follows the arrows counterclockwise around the first chair, comes back clockwise around the second chair, performs a shuttle run between the two parallel lines making five passes, and then finishes by stepping on the Dekan timer mat. Each subject times the three minute rest on a constantly running Kokak timer, model #8239.

The test administrator records the trial score to the nearest 1/100 of a second. Elapsed time between contacts of the Dekan timer switch mats represent the trial score. The principal investigator calculates to the nearest 1/100 of a second the mean of the first 3 trials on the first day and the mean of the best 3 trials on the second day representing respectively the Earlytrial Performance and the Latertrial Performance of the Spatial Motor Task.

Spatial/temporal Motor Task. The Spatial/temporal Motor Task involves the following procedure. From a standing position behind the starting line the subject initiates the task by stepping on the Dekan timer mat, runs along the right side of the first chair to the stationary soccer ball, moves the ball counterclockwise around the chair, from behind the restraining line kicks the ball into section 1 on the wall, regains possession, then kicks the ball into section 2 on the wall, moves the ball clockwise around the second chair, moves as quickly as possible along the course kicking the ball into section 2 on the wall then into section 1 on the wall, kicks the ball across the start/finish line, and steps on the second Dekan timer mat. Subjects time the 3 minute rest on a constantly running General Electric timer, model #50-20101-02.

Three extra soccer balls are positioned on the floor outside the black line and opposite each 3 foot vertical line on the wall. These extra balls may be selected as an alternative to chasing any loose ball moving outside the area bounded by the start/finish line, black line, and second chair. All soccer balls are inflated to 5 pounds per square inch and checked twice each day.

The test administrator records the trial score to the nearest 1/100 of a second. Earlytrial Performance of the Spatial/temporal Motor Task is represented by the mean of the first 3 trials of the first day calculated to the nearest 1/100 of a second. Latertrial Performance of the Spatial/temporal Motor Task is the mean, to the nearest 1/100 second, of the best 3 of the 6 trials on the second day. Performance scores are calculated by the principal investigator.

Treatment of Data

Treatment of the data is organized into four categories (a) sample data reduction, (b) determination of the reliability of the variable measures, (c) determination of the interrelationships among the 9 variables, and (d) determination of the factors underlying all 9 variables. Following is the description of data treatment for each category.

Sample Data Reduction

Of the 94 subjects who actively participated in the study, there were 80 subjects who completed all 9 tasks. Fourteen subjects were dropped from the analysis because of incomplete information about them. Inclusion of these 14 subjects would cause inflated loadings and communalities of the variables with missing data. In the present study the data matrix reduction is the most accurate solution as other alternative methods would cause estimating specific motor responses from general visual perceptual attributes to be substituted in the data matrix or cause reduced correlation of the motor and perceptual variables.

Reasons given by the 14 subjects for dropping out of the study include the following. During the course of the data collection two subjects dropped out of school, one had emergency surgery, one developed a major illness, one was appointed to two community positions, three had unexpected paper/exams assigned, three developed scheduling problems, and three did not respond to the questionnaire or return the phone messages.

Therefore, a sample of 80 subjects' responses on 9 variables is analyzed for the descriptive purpose of this study. All analytic techniques which follow are applied to the 80 subject data set. These data (for all 80 subjects) are presented in Appendix D, pages 146-156.

Reliability of the Variable Measures

The interindividual reliability is determined for 8 variables with scores of odd trials as independent variables and scores of even numbered trials as the dependent variables. Interindividual reliability is calculated for the Differential Aptitude Space Relations Test, Rod-and-Frame Test, Periometer Task, Bassin Timer Task, First Day Spatial Motor Task, and Second Day Spatial/temporal Motor Task. The Spearman-Brown Prophecy Formula is applied to each correlation coefficient. The Statistical Analysis System linear regression program calculates the weights for the linear equation, the coefficient of determination, and provides an F-test and probability value for the linear equation.

Intraindividual reliability is computed by the odd-even method for seven variables including the Rod-and-Frame Test, Periometer Task, Bassin Timer Task, First and Second Day Spatial Motor Task, and First and Second Day Spatial/temporal Motor Tasks. The Pearson Product-moment Correlation is applied to the visual perceptual task scores. The Spearman Rank Order Correlation is applied to the gross motor task scores.

Interrelationships Among the Variables

Means, standard deviations, standard errors, minimum and maximum values are calculated by the MEANS procedure, and the correlation matrix is calculated for all 9 variables by the factor analysis procedure, FACTOR, of the Statistical Analysis System (Barr et al., 1976). This information provides the response for subproblems 1, 2, 3, and 4, pp. 2 and 3.

Underlying Factors

A principal component factor analytic model is used to generate the underlying factors providing the response to subproblem 5. Component factor analysis concerns the space defining the total variance of the variables in the study (Rummel, 1970). Descriptive in nature, component factor analysis operates from a basic matrix, R, of multiple correlations including the relationships of each pair of variables as the off diagonal elements. Entries in the main diagonal of the correlation matrix, R, remain equal to 1.000.

The FACTOR procedure of the Statistical Analysis System (Barr et al., 1976) is used to calculate the principal axes method to a Promax rotation. Raw data scores are converted to standard scores, and the subsequent standardized scores are used for all succeeding calculations. This standardization allows for better comparison of data with different sized means and variation.

The following are the criteria for inclusion of the principal components in the factor analysis. All eigenvectors with eigenvalues greater than or equal to 1.000 are maintained for further analysis, and eigenvectors with eigenvalues less than but close to 1.000 are evaluated on the basis of a sharp change in proportion of total variance and the eigenvalue (Rummel, 1970 and Child, 1970).

The principal axes method is chosen because it is geometric in concept and because there is more precedence for its use. These underlying reasons suggest greater potential for interpretation, comparison, and communication of the results. Oblique rotation is selected because the interrelated clusters of variables are better defined and the correlation of the resulting factors are reported. If clusters of variables of factors are empirically orthogonal, then orthogonal generated factors result from the oblique rotation (Rummel, 1970). Promax method is based upon rotating the Varimax orthogonal results raised to a power, k, and uses an ideal fit to an ideal oblique solution. The larger the value of k the more oblique are the results (Hendrickson & White, 1964).

The advantages of Promax are its reference to geometric solutions, speed of operation, and its comparative frame of reference to other popular but slower oblique solutions such as Binormanin and Oblimin (Hendrickson & White, 1964, and Rummel, 1970). The Statistical Analysis System (Barr et al., 1976) procedure FACTOR with Promax rotation prescribed provides a principal components matrix, eigenvalues and communalities; a Varimax matrix of factor loadings; and a Promax factor pattern matrix, factor structure matrix and factor correlation matrix. Thus, the prerotation, orthogonal, and oblique factor structures/ patterns can be compared. Because the optimal value of $k = 4$ is best for most data, it is used in applying the Promax rotation to these data (Hendrickson & White, 1964).

When 1.000 is used in the major diagonal of the correlation matrix, R; the off diagonal correlations are low; and the number of variables, n, is less than 10; there is an influence of $1/(n-1)$ by the major diagonal elements of the off diagonal correlations causing possible inflation of the factor loadings (Rummel, 1970). The cutoff point for the factor loadings in this analysis is set at .500 to compensate for the possible inflation of factor loadings projected by the general phenomena stated above.

CHAPTER IV

ANALYSIS OF DATA

This investigation is designed to study the interrelationships and underlying factors of five visual perceptual attributes and two stages of performance on two gross motor tasks with different spatial/temporal environmental demands. The visual perceptual attributes are designated as Coincidence Anticipation, Field Dependence/independence, Perceptual Speed, Peripheral Range, and Spatial Relations. Earlytrial and Latertrial Performance on the Spatial Motor Task and Earlytrial and Latertrial Performance on the Spatial/temporal Motor Task are designated as the stages of performance on the two gross motor tasks.

Data from eighty women undergraduate students enrolled in general physical education classes during the spring semester 1977 are used. The average age of the subjects is 19.52 years; the youngest is 18 and the oldest, 25. Approximately half of the subjects use corrective lenses for some reason. Sixteen percent of the sample is black and 84% is white, and the majority are freshmen. Table 1 summarizes the descriptive information concerning the sample.

The raw score and z-score for each subject on all nine variables are presented in Appendix D. The analysis of data is presented in the order in which it is calculated. Findings are organized in four categories: (a) interindividual reliability of seven variable measures, (b) intraindividual reliability of seven variable measures, (c) interrelationships among the nine variables, and (d) the factors underlying

Table 1

Description of the Sample

		Frequency(n)	%
Class	Freshmen	56	70.00
	Sophomore	15	18.75
	Junior	6	7.50
	Senior	3	3.75
Race	Black	13	16.25
	White	67	83.75
Corrective Lenses	No	42	52.50
	Yes	38	47.50

all nine variables. Analysis and explanation are indicated for each category.

Interindividual Reliability of the Variable Measures

Interindividual reliability is determined for eight variables using the odd-even method and is calculated by the REGR procedure of the Statistical Analysis System (Barr, Goodnight, Sall & Helwig, 1972). The Pearson Product-Moment correlation coefficient, the coefficient of determination, the linear equation for raw score conversion, the F test and the probability value for the linear equation are presented for each variable in Table 2. The Spearman-Brown Prophecy Formula shown in Figure 2 is applied to each Pearson Product-Moment correlation coefficient. The resultant r_x is reported in Table 2.

$$r_x = \frac{nr}{1 + (n-1)r}$$

r_x = Spearman-Brown prophecy correlation coefficient

r = Pearson Product-Moment correlation coefficient

n = # of parts of the test which are compared

Figure 2. Spearman-Brown Prophecy Formula (Barrow & McGee, 1971, p. 40).

Findings of the calculation reveal that the variable measures have high levels of reliability. The lowest r_x is .716, representing Day 1 of the Spatial/temporal Motor Task, and the highest r_x is .992 for the Periometer Task. All regressions are significant with $p \leq .0001$. Results of the regression analyses on odd-even trials are presented below.

Table 2

Interindividual Reliability

	r^*	r^{2*}	Linear Equation*	Calculated F*	P	Spearman Brown r_x
RFT Field Dependence/independence	.864	.746	Even=.648+1.656 Odd	229.232	.0001	.927
DAT Spatial Relations	.794	.631	Even=2.689+.801 Odd	133.600	.0001	.885
BASSIN Coincidence Anticipation	.923	.852	Even=.010+.990 Odd	449.160	.0001	.960
PERIOM Peripheral Range	.984	.968	Even=3.884+1.046 Odd	2354.960	.0001	.992
DAY 1 SPATIAL First Day Spatial Task	.654	.428	Even=6.714+.619 Odd	58.248	.0001	.791
DAY 2 SPATIAL Second Day Spatial Task	.855	.730	Even=2.579+.850 Odd	211.278	.0001	.922
DAY 1 SPATEMP First Day Spatial/temporal Task	.557	.311	Even=14.034+.496 Odd	35.145	.0001	.716
DAY 2 SPATEMP Second Day Spatial/temporal Task	.660	.436	Even=9.246+.642 Odd	60.342	.0001	.795

*Values rounded to 3 decimal places from 5 places indicated on the computer print out

Coincidence Anticipation

The reliability of the Bassin Timer Task, a variable measure for Coincidence Anticipation, as represented by the Spearman-Brown Prophecy Formula applied to odd-even correlation is $r_x = .960$. The preliminary regression analysis provides a correlation coefficient of $r = .923$, a coefficient of determination of $r^2 = .852$, and the linear equation for predicting even trials from odd trials produces a calculated $F_{1,78} = 449.160$ which is significant at the .0001 level. The mean and standard deviation of odd trial scores are $M_{odd} = 1.046$ and $s_{odd} = 0.057$. For even trial scores the mean is $M_{even} = 1.045$ and the standard deviation is $s_{even} = 0.054$.

Field Dependence/independence

Interindividual reliability of the Rod-and-Frame Test, the variable measure of Field Dependence/independence, calculated by the Spearman-Brown Prophecy Formula is $r_x = .027$. Regression analysis using the odd-even method provides a correlation coefficient of $r = .864$ and a coefficient of determination of $r^2 = .746$. The resulting linear regression equation for predicting even trial scores from odd trial scores has a calculated $F_{1,78} = 229.232$ which is significant at the .0001 level. The means of odd and even trial scores are respectively $M_{odd} = 2.70$ and $M_{even} = 5.12$, and the respective standard deviations are $s_{odd} = 4.38$ and $s_{even} = 8.39$.

Peripheral Range

The Spearman-Brown correlation coefficient is $r_x = .992$ for the Periometer Task which measures Peripheral Range. A correlation coefficient of r = .984, a coefficient of determination of r^2 = .968, and the linear equation predicting even from odd trial scores with calculated $F_{1,78}$ = 2354.96 significant at the .0001 level are results of the regression analysis using the odd-even method of interindividual reliability. The mean and standard deviation of odd and even trial scores are respectively M_{odd} = 82.83, s_{odd} = 10.74, M_{even} = 82.79, and s_{even} = 11.42.

Spatial Relations

The interindividual reliability of the Differential Aptitude Tests subtest Space Relations is r_x = .885 as calculated by the Spearman-Brown Prophecy Formula. Regression analysis of odd and even numbered trial scores results in a correlation coefficient of r = .794, a coefficient of determination of r^2 = .631, and a linear regression equation with calculated $F_{1,78}$ = 133.60 which is significant at the .0001 level. The mean and standard deviation of odd and even trial scores are respectively M_{odd} = 19.04, s_{odd} = 5.06, and M_{even} = 18.53, s_{even} = 5.11.

Spatial Motor Task

The reliability of the First Day Performance of the Spatial Motor Task as represented by the Spearman-Brown Prophecy Formula applied to odd-even correlation is r_x = .791. The regression analysis provides a correlation coefficient r = .654, a coefficient of determination r^2 = .428, and the linear equation for predicting even trials from odd trials calculated at $F_{1,78}$ = 58.248 which is significant at the .0001 level. The mean and standard deviation of odd numbered trials is M_{odd} = 18.80 and s_{odd} = 1.77. For even numbered trials the mean is

M_{even} = 18.35 and the standard deviation is s_{even} = 1.68.

The reliability of the Second Day Performance of the Spatial Motor Task as represented by the Spearman-Brown Prophecy Formula is r_x = .922. The regression analysis provides a linear equation with calculated $F_{1,78}$ = 211.278 significant at the .0001 level, a coefficient of determination of r^2 = .730, and a correlation coefficient of r = .855. The means of odd and even numbered trials for Second Day Performance of the Spatial Motor Task are M_{odd} = 17.67 and M_{even} = 17.59, and the respective standard deviations are s_{odd} = 1.45 and s_{even} = 1.44.

Spatial/temporal Motor Task

The interindividual reliability of the First Day Performance of the Spatial/temporal Motor Task is r_x = .716 as calculated by the Spearman-Brown Prophecy Formula. Regression analysis of odd and even numbered trial scores results in a correlation coefficient of r = .557, a coefficient of determination r^2 = .311, and a linear regression equation with calculated $F_{1,78}$ = 35.145 which is significant at the .0001 level. The mean and standard deviation of odd and even trials are respectively M_{odd} = 30.90, s_{odd} = 5.65 and M_{even} = 29.35, s_{even} = 5.02.

The Spearman-Brown Prophecy Formula correlation coefficient is r_x = .795 for the Second Day Performance of the Spatial/temporal Motor Task. A correlation coefficient of r = .660, a coefficient of determination of r^2 = .436, and the linear equation with calculated $F_{1,78}$ = 60.342 significant at the .0001 level are results of the regression analysis. The mean and standard deviation for odd numbered trial scores for Second Day Performance of the Spatial/temporal Motor

Task are $M_{odd} = 27.08$ and $s_{odd} = 4.47$. For even trial scores the mean is $M_{even} = 26.63$ and $s_{even} = 4.35$.

Intraindividual Reliability of the Variable Measures

The intraindividual correlation coefficients, degrees of freedom, and coefficient of determination for each of seven variables is calculated. The MULREG program of the Hewlett-Packard Time-Shared Basic package is applied to the odd and even numbered trial scores for each individual on the variables Bassin Timer Task, Rod-and-Frame Task, and Periometer Task. Spearman Rank order correlation is applied to the First and Second Day Trials of the Spatial Motor Task and the First and Second Day Trials of the Spatial/temporal Motor Task. Within each task, the intraindividual reliability has a wide range. This range derives from the subjects' individual variability within task execution.

Interrelationships among Variables

The correlations and descriptive statistics of all nine variables in the study are presented in Table 3, p. 61. The relationships are presented and discussed in order of answering subproblems 1, 2, 3, and 4 as indicated on pages 2-3. Statistical Analysis System (Barr et al., 1976) procedure FACTOR provides the correlation matrix for all variables in the factor analysis, and procedure MEANS provides the descriptive statistics.

Subproblem 1--Relationships between performance stages within each gross motor task

The Earlytrial Performance and Latertrial Performance of the Spatial

Table 3

Descriptive Statistics and Interrelationships Among Variables

	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
RFT Field Dependence/independence	-.218	.091	.110	.173	-.195	-.150	.136	.067
DAT Spatial Relations		.144	-.014	-.492*	.010	-.030	-.134	-.173
BASSIN Coincidence Anticipation			-.067	-.026	.065	.161	.034	.210
PERIOM Peripheral Range				.033	-.159	-.163	-.023	-.122
EFT Perceptual Speed					.011	.111	-.071	.020
SPATIAL1 Earlytrial Spatial Task						.595**	.110	.319**
SPATIAL2 Latertrial Spatial Task							.337**	.579**
SPATEMP1 Earlytrial Spatial/temporal Task								.637**

	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
Mean	3.766	37.600	1.046	82.812	43.188	19.227	17.187	31.650	23.911
Standard Deviation	5.958	9.688	0.052	11.034	21.046	1.848	1.370	5.755	3.486
Minimum	.170	16.000	0.936	59.170	12.000	15.530	14.710	20.970	17.010
Maximum	30.000	56.000	1.171	100.000	100.000	27.030	21.470	47.680	33.640
Standard Error	.666	1.083	0.006	1.234	2.361	0.206	0.153	0.643	0.390
Coefficient of Variation	158.211	25.767	4.945	13.324	49.244	9.608	7.975	18.184	14.580
Skewness	2.892	-0.096	0.164	-0.726	0.725	1.346	0.453	0.371	0.454

*p=.05, r critical value = .220 and ** p = .01, r critical value = .290
n=80

Coefficient of Variation # = s/M

Motor Task have a correlation of $r = .595$ with significance of $p \leq .01$. The coefficient of determination is $r^2 = .354$. Correlation of the Early-trial and Latertrial Performance of the Spatial/temporal Motor Task provides an $r = .637$ significant at $p \leq .01$ level and the coefficient of determination is $r^2 = .426$.

In both motor tasks the early stages are significantly related to the later stages of performance with $p \leq .01$. The Earlytrial Performance and Latertrial Performance of the Spatial Motor Task are more consistent, less variable, within each performance stage. Analysis shows that they have less common variability than the Earlytrial and Latertrial Performance of the Spatial/temporal Motor Task. The standard deviation of Earlytrial Performance of the Spatial Motor Task, $s_{SPATIAL1} = 1.848$, is small and relatively close to $s_{SPATIAL2} = 1.370$, the standard deviation of the Latertrial Performance of the Spatial Motor Task. The Earlytrial Performance of the Spatial/temporal Motor Task and Latertrial Performance of the Spatial/temporal Motor Task have greater variability than either stage of the Spatial Motor Task, and the standard deviations $s_{SPATEMP1} = 5.755$ and $s_{SPATEMP2} = 3.486$ are not as close as the standard deviation of the two stages of the Spatial Motor Task. The two performance stages of the Spatial/temporal Motor Task have 42.6% common variability. It is also noted that the Earlytrial and Latertrial Performance of the Spatial Motor Task are significantly related as are the Earlytrial and Latertrial Performance of the Spatial/temporal Motor Task. The two stages of the Motor Task with the same spatial and temporal environmental demands share the greater percentage of common variability and the higher correlation.

Subproblem 2--Relationships among Spatial and Spatial/temporal Motor Tasks

There are three correlations significant at p .01 level. The highest correlation, $r = .579$, is between Latertrial Performance of the Spatial Motor Task and Latertrial Performance of the Spatial/temporal Motor Task. The coefficient of determination is $r^2 = .335$.

The second highest relationship between gross motor tasks is the correlation of Latertrial Performance of the Spatial Motor Task with Earlytrial Performance of the Spatial/temporal Motor Task. The correlation coefficient is $r = .337$, and the coefficient of determination is $r^2 = .142$.

The third correlation significant at p .01 is between the Early-trial Performance of the Spatial Motor Task and the Latertrial Performance of the Spatial/temporal Motor Task. The relationship produces $r = .319$ and $r^2 = .101$.

The fourth relationship to which subproblem 2 refers is not significant at $p \leq .05$. Earlytrial Performance of the Spatial Motor Task and Spatial/temporal Motor Task do not have a significant correlation at $p \leq .05$, $r = .110$ and $r^2 = .010$.

The Latertrial Performance measures of the Spatial and Spatial/temporal task share the highest percent of common variability, 33.5%, of the cross task correlations. This relationship across tasks of $r = .579$, although significant at $p < .01$, is less than either of the within task correlations presented under subproblem 1. The two remaining relationships across gross motor tasks significant with $p < .01$ are much lower. The Latertrial Performance of the Spatial Motor

Task and the Earlytrial Performance of the Spatial/temporal Motor Task have 14.2% common variability; and the Earlytrial Performance of the Spatial Motor Task and the Latertrial Performance of the Spatial/temporal Motor Task have 10.1% common variability. Thus, there is higher relationship between stages of performance within each gross motor task than with stages of performance between the two gross motor tasks with varied spatial/temporal demands.

Subproblem 3--Relationships among the Visual Perceptual Attributes

When the measures of five visual perceptual attributes are correlated, only one of the ten correlations is significant at the $p \leq .05$ level.

Differential Aptitudes Space Relations Test and Embedded Figures Test are inversely correlated at $p \leq .01$ level with $r = -.492$ and $r^2 = .243$. Subjects scoring more correct answers on the Space Relations Test in the fixed time period were more apt to be faster in disembedding the simple from the complex figures of the Embedded Figures Test.

The following five correlations are positive but not significant at $p \leq .05$: (a) Bassin Timer Task and Rod-and-Frame Task, $r = .091$; (b) Bassin Timer Task and Space Relations Test, $r = .144$; (c) Periometer Task and Rod-and-Frame Task, $r = .110$; (d) Embedded Figures Test and Rod-and-Frame Task, $r = .173$; and (e) Embedded Figures Test and Periometer Task, $r = .033$. The following four correlations are negative but not significant at $p \leq .05$: (a) Rod-and-Frame Task and Space Relations Test, $r = -.218$; (b) Periometer Task and Space Relations Test, $r = -.014$; (c) Periometer Task and Bassin Timer Task, $r = -.067$; and (d) Periometer Task and Embedded Figures Test, $r = -.026$.

The results of the intercorrelations of five visual perceptual attributes yield but one significant relationship. Spatial Relations and Perceptual Speed are significantly related at $p < .01$ and have 24.3% common variability. The relationship implies the better the Spatial Relations the greater the likelihood of having fast Perceptual Speed. The inverse would also be likely.

Subproblem 4--Relationships among Visual Attributes and Performance Stages of Gross Motor Tasks

There are no significant correlations at the .05 level between pairing of the visual perceptual attributes with performance stages of gross motor tasks. Thus, when selecting one performance variable and one visual perceptual attribute, each relationship is small. The highest common variability, 4%, is between the Bassin Timer Task and Latertrial Performance on the Spatial/temporal Motor Task with $r = .210$.

Underlying Factors

Component factor analysis is utilized to fulfill the purposes of this research and to provide the answer to subproblem 5. This analytic technique is concerned with relationships among the observable processes presumed to be generating the responses (Harris, 1975) and is based upon the space defining the total variance of the variables in the study (Rummel, 1970). The FACTOR procedure of the Statistical Analysis System (Barr et al., 1976) is used to compute the principal axes method to a Promax oblique rotation using $k = 4$. A factor loading greater than or equal to .500 is used as the cutoff point for variables contributing to the factor composition. Rationale for decisions and description of procedures regarding the analytic technique are presented in Chapter 3, pages 50-51. All factor loadings refer to standardized scores of the nine variables included in the study.

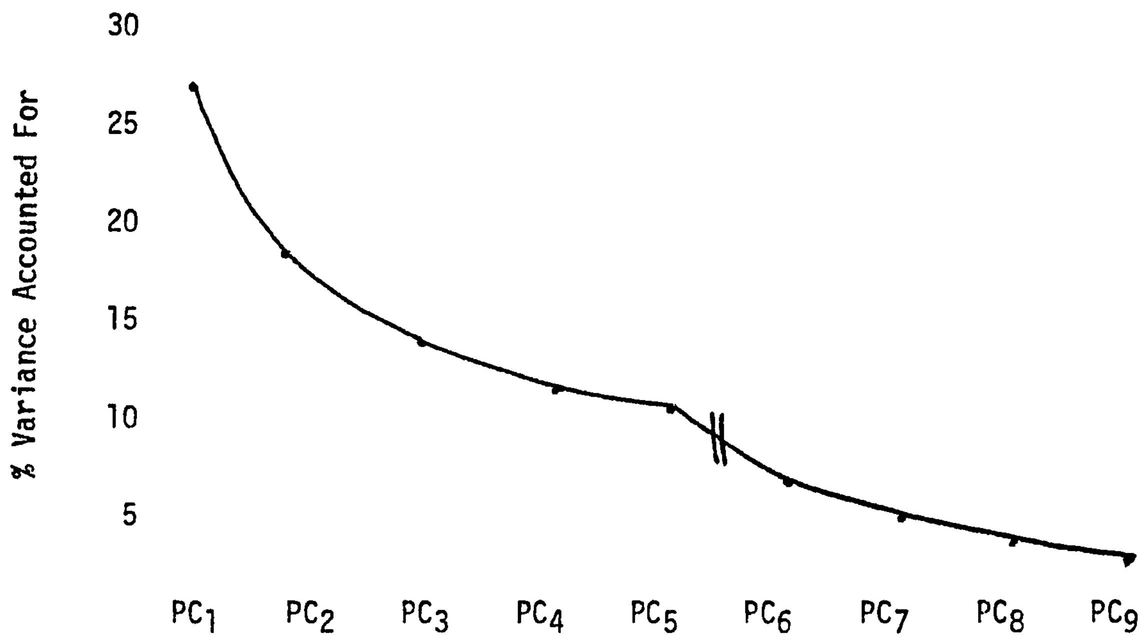
The FACTOR procedure applied to the nine variables of 80 college female subjects produces (a) a principal component analysis, (b) a Varimax orthogonal analysis, and (c) a Promax oblique analysis. The analytic results are presented in the above order because the calculations are sequential.

Principal Component Analysis

Initial principal component analysis provides the variance, eigenvalue, of each of nine orthogonal components which account for maximum amount of remaining total variance. Variance, percent of total variance, cumulative percent of variance, and a graph of the percent of variance accounted for by each principal component is presented in Figure 3.

Five factors are retained for rotation in accord with the criteria for inclusion of principal components, PC, presented in Chapter 3, p. 51. The nature of the graph is curvilinear from PC_1 to PC_5. Between PC_5 and PC_6 there is a sudden change in the percent of total variability, and the graph becomes more linear in nature. Eighty-one percent of the total variability is accounted for by the five factors.

Table 4 presents the eigenvectors of the five principal components retained for rotation. There are apparently three common components vaguely defined and two unique components strongly defined. PC_1 accounts



	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9
Eigenvalue	2.441	1.683	1.252	1.000	.905	.656	.477	.302	.272
% Total Variability	27.1	18.7	13.8	11.4	10.4	7.3	5.3	3.4	3.0
Cumulative %	27.1	45.8	59.6	71.0	81.0	88.3	93.6	47.0	100.0

Figure 3. Variance of Principal Components (derived by FACTOR procedure, Statistical Analysis System (Barr et al., 1976), Model = Component, Method = Principal Axes).

Table 4

Principal Component Analysis

	Eigenvectors PC1	PC2	PC3	PC4	PC5	h^2
RFT Field Dependence/independence	-.024	.462	.428	.237	-.078	.651
DAT Spatial Relations	-.112	-.602	.225	.062	.122	.752
BASSIN Coincidence Anticipation	.162	-.117	.329	.792	.211	.903
PERIOM Peripheral Range	-.165	.180	.246	-.312	.878	.994
EFT Perceptual Speed	.060	.536	-.418	.266	.152	.804
SPATIAL 1 Earlytrial Spatial Task	.402	-.216	-.384	.033	.268	.724
SPATIAL 2 Latertrial Spatial Task	.542	-.102	-.117	.013	.195	.807
SPATEMP 1 Earlytrial Spatial/temporal Task	.422	.133	.418	-.369	-.168	.847
SPATEMP 2 Latertrial Spatial/temporal Task	.544	.083	.231	-.087	-.053	.811
Eigenvalue	2.441	1.683	1.242	1.022	.905	
% of Total Variability	27.1	18.7	13.8	11.4	10.1	

*h^2 = communality estimate, 100 X h^2 equals percent of variability accounted for by the five factors.

for 27.1% of the total variability and has loadings primarily indicating emphasis of the gross motor tasks. The second principal component accounts for 18.7% of the total variability and represents primarily Space Relations and Perceptual Speed and some effect of Field Dependence/independence. Of the total variability, 13.8% is accounted for by PC_3 which has loadings greater than .400 on Field Dependence/independence, Perceptual Speed, and Earlytrial Performance on the Spatial/temporal Motor Task. The two unique components are PC_4 accounting for 11.4% of the total variability which contains a high loading of Coincidence Anticipation and PC_5 accounting for 10.1% of the total variability and having a high loading from Peripheral Range.

The communality of the variables across the five factors is also presented in Table 4. Sixty-five percent of the variability of the Field Dependence/independence measure, 75.2% of the variability of the Space Relations measure, 90.3% of the variability of the Coincidence Anticipation measure, 99.4% of the variability of the Peripheral Range measure, and 80.4% of the variability of the Perceptual Speed measure is accounted for by the five factors. Among the measures of performance of the gross motor tasks, 72.4% of the variability of Earlytrial Spatial Motor Task, 80.7% of the variability of the Latertrial Spatial Motor Task, 84.7% of the variability of the Earlytrial Spatial/temporal Motor Task, and 81.1% of the variability of Latertrial Spatial/temporal Motor Task are accounted for by the five factors. These communality estimates remain constant throughout the orthogonal and oblique rotations.

The principal component analysis accounts for most of the variability of each variable with the least contribution to Field

Dependence/independence. Most of the total variability of the data space, 81.0%, is accounted for by the five factors retained for rotation.

Varimax Orthogonal Analysis

The purpose of the Varimax rotation is twofold. First, the Varimax technique maintains the orthogonality of factors and accountability for the established 81.0% of total variability. Secondly, Varimax allows the factor vectors to approach the cluster of variables and results in clarification of the loadings of variables on respective factors.

Table 5 indicates the Varimax rotated factor matrix, approximate eigenvalues, and percent of total variability. Clarity of factor contribution is attained when the criterion of loadings greater than .500 is applied. Three common factors and two unique factors are represented which account for approximately 81% of the total variability of the variables in the study. The variance of each factor, the eigenvalue, is more uniform than in the principal components analysis.

Factor I is a common factor containing high loadings on Earlytrial Performance of the Spatial/temporal Motor Task and accounting for approximately 20.8% of the total variability. Earlytrial Performance of the Spatial/temporal Motor Task correlates with Factor I having an r = .917. The relationship of Factor I and Latertrial Performance of the Spatial/temporal Motor Task is r = .819. A low score on Factor I represents the fast speed of performance on the Spatial/temporal Motor Task.

Factor II, a common factor, contains loadings above .500 on Perceptual Speed and Spatial Relations and accounts for 17.7% of the

Table 5

Varimax Rotated Factor Matrix

	FACTORS I	II	III	IV	V
RFT Field Dependence/independence	.283	-.358	.565	-.336	.104
DAT Spatial Relations	.188	.819	-.081	-.192	.035
BASSIN Coincidence Anticipation	.041	.093	-.069	-.941	-.043
PERIOM Peripheral Range	-.035	-.013	.100	.035	.991
EFT Perceptual Speed	-.141	-.875	-.104	-.078	.043
SPATIAL 1 Earlytrial Spatial Task	.120	-.042	-.837	-.065	-.054
SPATIAL 2 Latertrial Spatial Task	.452	-.098	-.752	-.154	-.058
SPATEMP 1 Earlytrial Spatial/temporal Task	.917	.028	-.010	.064	.014
SPATEMP 2 Latertrial Spatial/temporal Task	.819	-.089	-.311	-.172	-.073
Calculated Eigenvalue	1.871	1.593	1.713	1.104	1.009
% Total Variability	20.8	17.7	19.3	12.3	11.2

Values above the cutoff point of .500 are underlined total variability. Perceptual Speed and Spatial Relations account for 17.7% of the total variability. Perceptual Speed as measured by the Embedded Figures Test (Witkin et al., 1971) correlates with Factor II with r = -.875. Spatial Relations as measured by the Differential Aptitudes Subtest Space Relations (Bennet et al., 1973) relates to Factor II with r = .819. The faster the perceptual speed and the greater the spatial relations capability the higher would be the factor score for Factor II. A high factor score for Factor II represents fast speed of extracting and interrelating pertinent environmental information.

Factor III, a common factor, is representative of elements of the Spatial Motor Task and Field Dependence/independence and accounts for 19.3% of the total variability. The highest relationship or loading is r = -.837 between Factor III and Earlytrial Performance on the Spatial Motor Task. Second highest relationship is r = -.752 between Factor III and Latertrial Performance on the Spatial Motor Task. The third variable loading on Factor III, .565, is Field Dependence/independence as measured by the Rod-and-Frame Test. A high factor score on Factor III represents Field Dependence and fast performance on the Spatial Motor Task.

The first of the two unique factors is Factor IV which contains a loading of -.941 for Coincidence Anticipation as measured by the Bassin Timer Task. Factor IV accounts for 12.3% of the total variability. A high factor score for Factor IV indicates accurate coincidence anticipation.

Factor V, the second unique factor, is representative of Peripheral Range and accounts for 11.2% of the total variability of variables included in the study. The relationship between Factor V represents wide peripheral range for detecting movement.

Promax Oblique Analysis

The factor pattern and factor structure matrices for the primary axes of the Promax analysis with k = 4 are presented in Table 6, p.74. Whereas in orthogonal rotations there is only one factor matrix containing both pattern and structure projections, in oblique rotations there are two types of matrices referring to the primary axes.

The factor pattern matrix is recommended for determining clusters of variables defined by the oblique factors. Loadings representing projections of a point by lines parallel to the axes are indicated. As a point becomes closer to one axis, the projection on the other will become smaller. As a factor axis is placed through a cluster of variables the projections on other variables will approach zero. It is possible for pattern factor loadings to be greater than 1.000 as they are similar to regression coefficients (Rummel, 1970).

The factor structure matrix contains factor loadings which are the product-moment correlations of the variables with the factors. The factor structure loadings refer to the distance on a factor axis determined by a line drawn perpendicular to the axis from the point representing the variable. The structure loadings of a variable on two factors measure the relationship of the variables with each factor and the interrelationships of the two factors as expressed by the inter-factor correlation. The greatest value of this matrix is in measuring the variance accounted for by the factor and factor interrelationships. This variance is the factor structure loading squared (Rummel, 1970).

Table 6

Promax Primary Axes Factor Matrices*

	FACTOR PATTERN MATRIX					FACTOR STRUCTURE MATRIX				
	I	II	III	IV	V	I	II	III	IV	V
RFT Field Dep/ind.	.277	-.282	.590	-.312	.051	.302	-.423	.549	-.370	.174
DAT Spatial Relations	-.139	.820	-.066	-.242	.060	-.254	.828	-.104	-.128	.005
BASSIN Coincidence Anticip.	-.093	.124	-.038	-.966	-.029	.129	.051	-.100	-.934	-.059
PERIOM Peripheral Range	.001	.016	-.023	.032	1.002	-.062	-.033	.197	.052	.996
EFT Perceptual Speed	-.277	-.918	-.162	-.063	.034	-.026	-.852	-.036	-.098	.062
SPATIAL 1 Earlytrial Spatial	.009	-.086	-.851	-.045	.025	.201	-.030	-.844	-.111	-.159
SPATIAL 2 Latertrial Spatial	.349	-.095	-.734	-.103	.016	.536	-.129	-.797	-.248	-.162
SPATEMP 1 Earlytrial Spatial/temp.	.979	.137	.070	.154	.025	.895	-.074	-.112	-.070	-.018
SPATEMP 2 Latertrial Spatial/temp.	.788	-.011	-.240	-.091	-.037	.862	-.177	-.404	-.305	-.135

Values above the cutoff point of .500 are underlined

*K = 4

The purpose of applying the Promax oblique rotation is to allow the orthogonal axes determined by the Varimax technique to approach the variable clusters without geometric restrictions and then to determine if there are relationships among the factor scores (Hendrickson & White, 1964).

Evaluation of the Promax Factor Pattern Matrix in Table 6 shows the same five factors as the Varimax Factor Pattern in Table 5, p. 71 with greater clarity. The factor vectors approach the variable clusters more closely in the oblique rotation because most of the nonsignificant factor pattern loadings are lower and most of the significant factor pattern loadings are higher.

The first common factor is Factor I which contains loadings of .979 and .788 respectively on the Earlytrial and Latertrial Spatial/temporal Motor Tasks as shown in the Factor Pattern Matrix. Approximately 80.1% (.895) of the variability of the Earlytrial Spatial/temporal Motor Task and 74.3% (.862) of the variability of Latertrial Spatial/temporal Motor Task is accounted for by Factor I and interfactor relationships. A low factor score represents fast speed during early performance stages of the Spatial/temporal Motor Task.

Factor II is a common factor which contains factor pattern loadings of -.918 and .820 of Perceptual Speed and Spatial Relations respectively. The evaluation of the factor structure loading indicates that 72.6% of the variability of Perceptual Speed and 68.6% of the variability of Spatial Relations is accounted for by Factor II and interfactor correlations. A high score on Factor II represents the ability to quickly extract pertinent spatial interrelationships from the environmental display.

Evaluation of the factor pattern matrix for Factor III indicates: Earlytrial Performance on the Spatial Motor Task has a loading of -.851, Latertrial Performance on the Spatial Motor Task has a loading of -.734, and Field Dependence/independence reveals a loading of .590. Respectively, 71.2%, 63.5%, and 30.1% of the variability of Earlytrial and Latertrial Spatial Motor Performance and Field Dependence/independence is accounted for by Factor III and the interrelationships of factors. A high score on Factor III, a common factor, represents Field Dependence and fast, early performance on the Spatial Motor Task.

Factor IV is the first of two unique factors with a factor pattern loading of -.966 from Coincidence Anticipation. Calculation from the factor structure loadings indicates that 87.2% of the total variability of Coincidence Anticipation is accounted for by Factor IV and interfactor correlations. Accurate coincidence anticipation is represented by a high score on Factor IV.

Peripheral Range has a factor pattern loading of 1.002 on Factor V, the second unique factor. Approximately 99% of the variability of Peripheral Range is accounted for by Factor V and interfactor correlations. Wide peripheral range is represented by a high score on this fifth factor.

The Interfactor Correlation Matrix presented in Table 7, p. 77, contains three significant interfactor correlations with p .05 and N = 80. Factor I is significantly related to Factor II and Factor IV, and Factor III is significantly related to Factor V. There are seven nonsignificant interfactor correlations.

Table 7

Interfactor Correlation Matrix

	FACTORS			
	II	III	IV	V
Factor I	-.225*	-.193	-.248*	-.056
Factor II		-.076	.102	-.053
Factor III			.066	.220*
Factor IV				.020
Factor V				

*p=.05, n=80, r critical value = .220

Highest of the interfactor correlations is r = -.248 between Factor I and Factor IV. The implication is that accurate coincidence anticipation, Factor IV, and fast early performance on the Spatial/temporal Motor Task, Factor I, have approximately 6.1% common variability.

Factor I is also inversely related to Factor II with r = -.225, and approximately 5.1% common variability. This implies that there is some relationship between the ability to quickly extract pertinent spatial interrelationships from the environmental display, Factor II, and fast, early performance on the Spatial/temporal Motor Task, Factor I.

Factor III is significantly related to Factor V with r = .220, p = .05, and 4.8% common variability. The pattern of responding indicates a tendency for wide peripheral range, Factor V, to coincide with Field Dependence and fast early performance on the Spatial Motor Task.

Summary

Interindividual reliability of the measures used in the study are high. Thus, there is little random error; and a relatively large portion of data variability remains constant through replication for each measure (Rummel, 1970).

When selected two at a time, there are no significant correlations of a gross motor task and a visual perceptual attribute. There is only one significant relationship between two of the perceptual attributes studied, specifically Spatial Relations and Perceptual Speed. The highest interrelationship of stages of performance of the gross motor tasks are within tasks of the same spatial/temporal demands. Only earlytrial performance on both gross motor tasks are not significantly related.

Five factors underlying the data space of this study are extracted. Three common factors and two unique factors account for 81% of the total variability. Promax rotation further clarifies the five factors produced by Varimax rotation and demonstrates that there are low but significant interfactor relationships between the visual perceptual abilities and specific motor tasks with different spatial/temporal environmental demands.

Factor I represents the ability to move through the Spatial/temporal Motor Task at early stages of performance. Factor II represents the ability to extract and relate pertinent information from the environmental display. Factor III encompasses the ability to relate to the total environment while moving through the Spatial Motor Task at early stages of performance. Factor IV represents the ability to anticipate coincidence of events at relatively low speeds, and Factor V represents the ability to detect peripherally motion at relatively low speeds. Factor I is inversely related to Factor IV and Factor II. Factor III is directly related to Factor V.

CHAPTER V

DISCUSSION

Findings of this study are discussed in relation to the specific literature reviewed and the models and classic studies referred to in the Introduction and Significance of the Study presented in Chapter I. The discussion is organized into the following six categories: (a) visual perceptual attributes, (b) gross motor tasks, (c) visual perceptual attributes and gross motor tasks, (d) motor task taxonomy, (e) information processing, and (f) summary.

Visual Perceptual Attributes

The majority of published research in the last 10 years regarding the visual perceptual variables with which this study is concerned relates to field dependence/independence. Some of these studies used the Rod-and-Frame Test; others used the Embedded Figures Test (Witkin et al., 1971). Still others used the Group Hidden Figures Test. The Rod-and-Frame Test is representative of Field Dependence/independence. The Embedded Figures Test and Group Hidden Figures Test concern speed of disembedding simple figures from complex figures, a form of Perceptual Speed.

Arbuthnot (1972) acknowledges a low relationship between the two forms of measuring field dependence/independence, suggests that they represent different entities, and encourages the use of the Rod-and-Frame Test and one of the two disembedding tests. Bergman and Engelbrektson

(1973) found a low relationship between the Rod-and-Frame Test and the Embedded Figures Test. Correlation coefficients of .23, .20, .40 are representative values. The results of the present study support the low relationship of the Rod-and-Frame Test and Embedded Figures Test (Witkin et al., 1971) with r = .173.

Intercorrelational results of Lasry and Dyne (1974) and factor analytic results of Bergman and Engelbrektson (1973) suggest that the Rod-and-Frame Test and Embedded Figures Test tap different dimensions. The high loadings on the two separate factors, Factor III and Factor II, in this study support this idea. In addition to the low correlation of the two tests, r = .173, the Promax oblique rotation lends credence to the relative independence of the underlying constructs with the extremely low interfactor correlation, -.076 of Factors II and III.

The average score of subjects on the Rod-and-Frame Test in this study is consistent with the average scores for college age females reported in the literature. The average RFT for this study is 3.766^{o} which is slightly above the average of mean RFT scores of 3.26^{o} found in the literature (Sherman, 1974 and Svinicki et al., 1974). The shape of the distribution and range of the scores for this study is very similar to that of the original sample used by Souder (1972). Range in this study was from $.170^{o}$ to 30.000^{o}, and the range for the total sample was 0^{o} to 35.1^{o} in the research reported by Souder (1972). Both distributions are skewed toward field dependence implying college females as a whole tend toward field independence. The present sample, N = 80, and Souder's (1972) original sample, N = 200, are much larger than the samples used by Sherman (1974), N = 25 and Svinicki et al. (1974), N = 20. These sampling differences may account, at least in part, for some of the differences in findings.

Average score and standard deviation on the Embedded Figures Test in this study, M = 43.188 seconds and s = 21.046 seconds, are lower than reported average scores and standard deviations for college age women. The range of average of EFT scores for college age women is from 59.96 seconds (Lasry & Dyne, 1974) to 66.9 seconds (Witkin et al., 1971), and the standard deviations range from 23.54 to 41.0 seconds as reported by the same respective sources. However, the sample size range from N = 22 (Lasry & Dyne, 1974) to N = 51 (Witkin et al., 1971) the sample for this study is larger, N = 80. Subjects who took part in the present study demonstrate somewhat faster disembedding abilities or faster Perceptual Speed.

Differential Aptitude Subtest Space Relations have reported average scores of 30.8 and 52.9 for 12th grade girls (Bennett et al., 1973) and 54.40 for college women (Sherman, 1974). The standard deviations for the respective studies reviewed are 12.4, 10.1, and 8.60. In the present study the mean of 37.600 correct and standard deviation 9.688 are approximately in the middle of the range of those reported in the literature.

Sherman (1974) describes another interrelationship among the visual perceptual attributes included in the present study. Spatial Relations and Field Dependence/independence are significantly correlated for 25 college females at $r = -.62$. In the present study with 80 college females the correlation is much lower and is not significant with p .05. Perhaps the sample size difference accounts for some of the discrepancy in findings. The fact that the present sample and Sherman (1974) sample have different average RFT scores, of 3.766° and 0.977° respectively may further explain the differing results.

The only other intercorrelation among visual perceptual attributes investigated in this study which is discussed in the published literature of the last ten years is between Spatial Relations and Perceptual Speed. Sherman (1974) reports a significant relationship between Space Relations and Perceptual Speed. Significant relationships are reported between Perceptual Speed and spatial orientation and space positioning by Bergman and Engelbrektson (1973). The present study lends support to these findings. Having a significant correlation of -.492 and loading on a common factor, Factor II, Perceptual Speed and Spatial Relations are shown to share common variance within college women.

Average Peripheral Range of subjects in the present study is approximately 5° lower than that associated with college age females whose data are discussed in the literature (Williams & Thirer, 1975). The study of Williams & Thirer (1975) includes athletes as well as nonathletes. The former show a significantly wider peripheral range. The present study includes relatively few college athletes in the sample, possibly accounting for some of the obtained minimal difference.

Subjects in this study tend to be more late rather than early in Coincidence Anticipation. The average Coincidence Anticipation is +.046 seconds with a standard deviation of .052. Sixty-three women have average scores that are late and 16 have average scores that are early. There are no published studies within the last 10 years that report

Coincidence Anticipation values for College Women with which comparison can be made.

Gross Motor Tasks

The stages of gross motor acquisition represented by the data in this study are compatible with two of Fitts' (1967) three phases of learning. The Early or Cognitive phase is characterized by a "patchwork of old habits ready to be put together into new patterns" (Fitts & Posner, 1967, p. 12). These characteristics are evident from the Earlytrial Performance scores on both the Spatial and Spatial/temporal Motor Tasks. These two performance scores reveal the slowest times and the most variable performances for each task within the practice period. Analysis of the performance scores individually or across individuals shows both tasks attain a general decline in time and variability, but neither approaches asymptote. The Latertrial Performance scores with lower means and less variability than the respective Earlytrial Performance are illustrative of the Intermediate or Associative phase of learning (Fitts & Posner, 1967). Fitts and Posner (1967) state that the Associative phase is characterized by the emergence of new patterns and the gradual elimination of errors.

There is evidence in this study that a rather consistent change in performance occurs within both the Spatial Motor Task and the Spatial/temporal Motor Task. The average performance scores and standard deviations decrease as practice continues. The Spatial/temporal Motor Task is the more difficult of the two gross motor tasks; this is indicated by the performance scores. Spatial/temporal Motor Task performance scores are higher and have higher standard deviations when compared between or within individuals than are the performance scores and standard deviations for the Spatial Motor Task. See Figure 4.

Visual Perceptual Attributes and Gross Motor Tasks

Fleishman (1967) suggests a strategy of investigation, namely the correlational/experimental approach. Over the years he, alone and with others, investigated factors underlying the performance stages of various complex coordination tasks (Fleishman, 1967, 1975 and Fleishman & Hempel, 1954, 1955 and Fleishman & Rich, 1966). The complex coordination tasks he studied involve total body stability with manipulation of objects with hands/arms and/or feet/legs. Fleishman & Hempel (1954, 1955) report visual perceptual abilities to be more related to earlier stages of performance with more emphasis on the specifics of the complex coordination task as practice continues. It follows from Fleishman's findings that in further study of skilled performance concerned primarily with visual attributes the early trials should be more related to such visual attributes than the later trials.

The present study is concerned with two motor tasks with total body transport, one with motion in the environment and the manipulation of an object and the other with a stable environment and no object manipulation. The factors extracted from the obtained data of this study support Fleishman & Hempel's (1954, 1955) findings. The two common factors, Factor I and Factor III, do have highest loadings of the Early-trial Performance of Spatial/temporal and Spatial Motor Tasks. In addition, the factors representing only visual attributes are

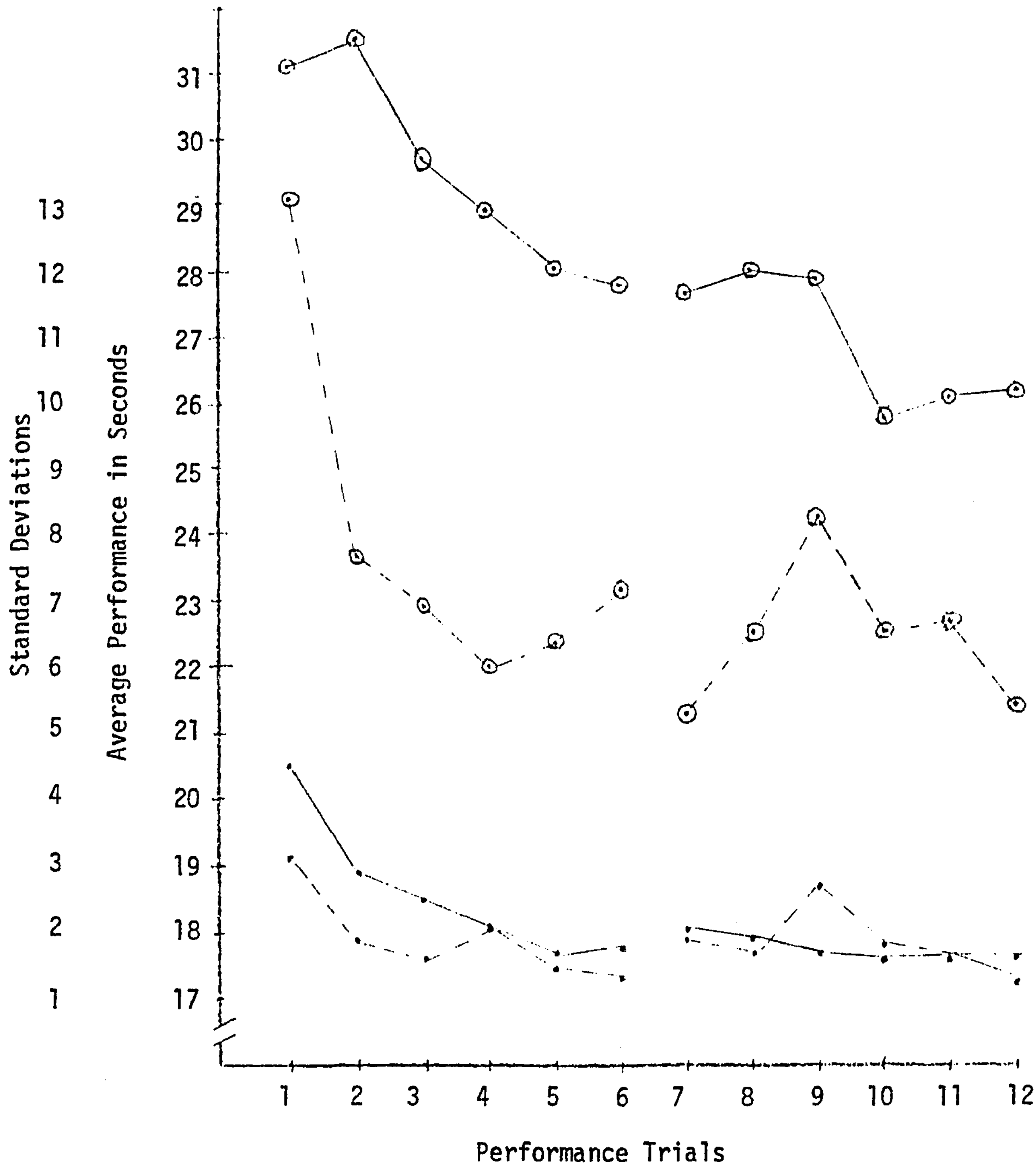


Figure 4. Trial Means and Standard Deviations of the Gross Motor Tasks (Spatial/temporal Task means ⊙—⊙, standard deviations ⊙- -⊙, and Spatial Task means •—•, standard deviations •- - -•).

relatively independent. The consistent unrelatedness of the factors when analyzed with Promax, an oblique rotation technique, is even more impressive.

The extremely low interfactor correlations of Factor II, the ability to detect quickly pertinent environmental information; Factor III, the ability to anticipate coincidence; and Factor IV, the ability to detect motion at a wide peripheral range, may be accounted for by (a) individual differences, and (b) the specificity of abilities. See Table 7, Chapter IV, p. 77.

Motor Task Taxonomy

Each gross motor task studied matches a different cell in the motor task taxonomy of Gentile et al. (1975). The Spatial Motor Task meets the following taxonomic criteria. First, the nature of environmental control is closed or spatial. Second, there is total body transport. Third, there is no independent limb transport. In contrast, the Spatial/temporal Motor Task includes (a) open or temporal/spatial environmental control, (b) total body transport, and (c) independent limb transport necessary to control and move the soccer ball in space.

The Promax analysis of the motor task performance data of this study supports the motor task taxonomy of Gentile et al. (1975). This is evidenced by the Earlytrial and Latertrial Performance of the Spatial/temporal Motor Task loadings on Factor I and the Earlytrial and Latertrial Performance of the Spatial Motor Task loadings on Factor III. Factors I and III represent the Earlytrial Performance slightly more than the Latertrial Performance of each respective motor task. Factors I and III are not significantly related when p .05. See Table 7 in Chapter IV, p. 77. Thus, two cells of the taxonomy of motor tasks (Gentile et al., 1975) are shown to be relatively independent as represented by performance during Cognitive and Associative phases of learning of college women.

The motor task taxonomy of Gentile et al. (1975) includes oculomotor/visual processes that seem to be associated with each motor task category. There are two oculomotor/visual processes associated with the taxonomic category to which the Spatial Motor Task is assigned. First, convergent/divergent and compensatory eye movements provide input relative to verticality and relationship of head/body and external objects. Second, convergent/divergent eye movements derive input regarding the environment into which the body is moving (Gentile et al., 1975, p. 13). There are two additional oculomotor/visual processes associated with the taxonomic category in which the Spatial/temporal Motor Task fits: saccadic eye movements provide input regarding location and features of stationary external objects, and slow pursuit and saccadic eye movements provide input regarding the spatial/temporal features of moving objects (Gentile et al., 1975, p. 13).

The Promax analysis of the five visual perceptual attributes and two stages of performance of two gross motor tasks provides additional support for the constructs underlying the model described by Gentile et al. (1975). The visual perceptual attributes of Coincidence Anticipation, Field Dependence/independence, Peripheral Range, Perceptual Speed and Spatial Relations are identified as unique factors or parts of common factors when analyzed simultaneously with the two gross motor tasks in this study.

Perceptual Speed and Spatial Relations load high on common Factor II which has a very low but significant relationship to Factor I, Spatial/temporal Motor Task. See Table 6, Chapter IV, page 74. Factor IV, a unique factor highly associated with Coincidence Anticipation, has a low correlation with Factor I, Spatial/temporal relations. Thus, the ability to select pertinent spatial information from the environment, Factor II, and the ability to anticipate coincidence, a spatial/temporal feature, represented by Factor IV, have a low but significant relationship to early performance stages of the Spatial/temporal Motor Task. These two Factors, II and IV, provide evidence of the oculomotor/visual processes associated with the Spatial/temporal Task category described by Gentile et al. (1975). It should be noted that such evidence is not also associated with the Spatial Task category. In other words, Factor II provides support that the Spatial/temporal Task taxonomic category necessitates deriving input regarding location and features of stationary objects from an abilities perspective. Factor IV provides support, within the abilities context, that the taxonomic category of the Spatial/temporal Motor Task necessitates deriving input regarding spatial/temporal features of the moving object. Within this study, the early performance of the Spatial/temporal Motor Task is slightly more related to the spatial/temporal features of the moving object than to the features and location of the stationary objects. Thus, the visual perceptual attributes associated with the Spatial/temporal Motor Task imply deriving input regarding the moving object and pertinent stationary environmental features.

The two remaining perceptual attributes either load with the Spatial Motor Task or form a unique factor which has a low but significant relationship to the Spatial Motor Task. Factor III, as presented in Table 6, Chapter IV, p. 74, is primarily representative of early performance of the Spatial Motor Task but includes a relatively high loading of Field Dependence. Factor V, the remaining unique factor, has a very high relationship to Peripheral Range. Factor III and Factor V have a low but significant relationship with each other. See Table 7, Chapter IV, p. 77. The implication is that performance of the Spatial Task relates most to Field Dependence but also to wide Peripheral Range. Field Dependence as measured by the Rod-and-Frame Test implies orienting primarily to the static environmental information in relation to oneself. Wide Peripheral Range would facilitate awareness of the amount of the surrounding environment which could be processed. Thus, the visual perceptual attributes associated with the Spatial Motor Task imply deriving input regarding the environment into which the body is moving as well as obtaining input concerning the relationship of the body and external objects. The above ideas are consistent with definitions of the oculomotor/visual processes ascribed to one motor task taxonomy category as presented by Gentile et al. (1975).

In summary, then, the motor task taxonomy of Gentile et al. (1975) is supported by the factors underlying the data of this study as derived from a Promax oblique rotation of principal axes. First, the Cognitive and Associative phases of learning the Spatial Motor Task and Spatial/temporal Motor Task load on separate factors which are relatively unrelated/independent. Second, each motor task is related to different perceptual attributes. And third, the perceptual attributes from the perspective of abilities support the oculomotor/visual process definition of the taxonomic categories of the Spatial Motor Task and the Spatial/temporal Motor Task. During the Cognitive and Associative phases of learning the Spatial Motor Task, abilities are more related to deriving information <u>from the environment into which the body is moving</u>. During the Cognitive and Associative phases of learning the Spatial/temporal Motor Task, abilities are more related to deriving information <u>concerning the moving object</u>.

<u>Information Processing</u>

Change in performance of gross motor tasks with practice is explained by numerous theoreticians according to an information processing model (Bernstein, 1967; Whiting, 1969; and Welford, 1968, 1972). Perception, translation, and effection are three information processes necessary to accomplish a desired task (Whiting, 1969). Gentile et al. (1975) report that one major difference in motor task organization as environmental demands become more complex is that the amount of preparation time (perception and translation) prior to movement (effection) increases in relation to the complexity of environmental demands. This implies that either more information processing and/or different types of information processing need(s) to occur prior to movement.

In the present study, the factor structure and interfactor correlations support the contention that different types of information processing are being applied as the environmental demands vary. The fact that there are lower loadings of the Latertrial Performance of the gross motor tasks in a context of visual perceptual abilities is supportive of the use of information processing in the learning process. The visual perceptual factors relate to factors with higher loadings of the Earlytrial Performance and lower loadings of the Latertrial Performance. The performance scores improve with practice and the variability of the performance scores decreases. Thus, it is reasonable to assume that although abilities are used in early phases of learning (Fleishman, 1954, 1955) the experience/practice in executing the task produces discrimination of task specific details (Whiting, 1969 and Connolly, 1970) which are manifested in improved performances.

Summary

Findings with respect to the visual perceptual attributes measured in this study are consistent with values and interrelationships reported in the literature within the past ten years. The execution of a spatial motor task and a spatial/temporal motor task reveal changes in performance through Cognitive and Associative phases of learning (Fitts & Posner, 1967). As compared to the results of Fleishman's classic studies (Fleishman, 1967, 1975 and Fleishman & Hempel 1954, 1955), the present study demonstrates the relative stability and independence of underlying abilities and the diminishing use of abilities with practice on gross motor tasks.

There are low relationships among visual perceptual abilities and low but significant relationships among visual perceptual abilities and gross motor tasks. There is greater intraindividual variability than interindividual variability. Both of the above underscore the strong role individual differences play in the learning of gross motor tasks.

The results of the study provide support for the relative mutual exclusivity of two taxonomic categories proposed by Gentile et al. (1975). The Spatial Motor Task and the Spatial/temporal Motor Task represent the Cognitive and Associative phases of learning of college age females.

The use of visual perceptual constructs evidenced in this study demonstrate basic differences in perceptual approaches to executing gross motor tasks with different spatial/temporal environmental demands. These findings have implications for the teacher/coach whose goal is the improvement of skilled performance.

CHAPTER VI

SUMMARY, RESEARCH CONCLUSIONS, AND IMPLICATIONS

Summary

The purpose of this descriptive study is to determine the underlying factors and interrelationships among five selected visual perceptual attributes and performance measures representing two stages of acquisition of two gross motor tasks with different spatial/temporal environmental demands. Eighty randomly selected undergraduate women registered in general college physical education classes served as subjects.

The two gross motor tasks have similar movement and spatial environmental demands. Both tasks are self initiated, serial in nature, and require speed with control as the specified criterion of accomplishment. The movement requirements of both motor tasks include running, simultaneous contacts of targets with both feet, clockwise and counter-clockwise movements around obstructions, and change of direction. The Spatial/temporal Motor Task involves interacting with a ball while moving in relation to targets and obstructions. The Spatial Motor Task involves moving only the self in relation to targets and obstructions. The basic difference in the environmental demands is the moving ball in the Spatial/temporal Motor Task. Earlytrial and Latertrial Performance of both tasks are accounted for by averaging the first three scores on the first day and averaging the best three scores on the second day.

Five visual perceptual variables are selected based on previous reported research about their role in the performance of gross motor tasks. Coincidence Anticipation is measured by the average time in milliseconds using the Bassin Anticipation Timer. Field Dependence/independence is represented by the average absolute error in degrees on the Rod-and-Frame Test. Perceptual Speed is measured by the time in seconds on the Embedded Figures Test, Form A. Peripheral Range is represented by the average score in degrees for the range at which motion is detected using the Keystone Periometer. The Spatial Relations measure is the score on Form T of the Differential Aptitude Subtest Space Relations.

Data were collected over a three week period of time during the spring 1977 semester. All assessments were made on a carefully scheduled basis by trained test administrators.

Data on nine variables for 80 subjects are analyzed using the procedures of the Statistical Analysis System (Barr et al., 1976). Descriptive statistics, reliability coefficients calculated by the odd-even method, and intercorrelations of all nine variables are computed. Promax oblique rotation of principal axes with 1.000 in the major diagonal is executed. Standardized scores of the variables are used as the basis of intercorrelations and factor analytic techniques.

The visual perceptual attributes measured in this study are consistent with values and interrelationships included in the literature within the past ten years. Both gross motor tasks evidence change of performance with practice through Cognitive and Associative phases of learning (Fitts & Posner, 1967). Interindividual reliability of all measures in the study is high ranging between .72 and .99.

Five factors underlying the data space are extracted. Three common factors and two unique factors account for 81% of the total variability. Factor I represents the ability to move through the Spatial/temporal Motor Task (ball) at early stages of performance. Factor II is associated with the ability to extract and relate pertinent environmental information. Factor III encompasses the ability to relate to the total environment while moving through the Spatial Motor Task (nonball) at early stages of performance. Factor IV represents the ability to anticipate coincidence of events at relatively low speed, and Factor V derives largely from the ability to detect peripherally motion at relatively low speed. Interfactor correlations reveal that Factor I is inversely related to Factor IV and Factor II. Factor III is directly related to Factor V. These relationships are low but significant with $p \leq .05$.

As compared to the results of Fleishman's earlier work, the present study demonstrates the relative stability and independence of underlying abilities. It is also consistent with Fleishman's finding of diminishing use of abilities with practice on motor tasks.

There are low relationships among abilities and low but significant relationships among visual perceptual abilities and gross motor task performance. There is greater intraindividual variability than inter-individual variability. Both of these findings underscore the strong role individual differences play in learning of gross motor tasks.

Using the motor task taxonomy of Gentile et al. (1975) as a definitive framework in a visuoperceptual-motor context, the results of the study provide support for the relative mutual exclusivity of two of their taxonomic categories. The implications are that the attainment of skill in executing gross motor performance calls for differing visual perceptual strategies that acknowledge both the spatial/temporal environmental demands of the task and the abilities of the individual.

Research Conclusions

The subproblems stated in Chapter I, p. 2-3, are answered by bivariate or multivariate analytic techniques. Subproblems 1 through 4 are answered by correlational techniques. Factor analysis with Promax oblique rotation of principal axes provides the answer to the fifth subproblem. Based upon the obtained data and its analysis the following conclusions are justified.

Subproblem 1. What are the relationships between earlytrial and latertrial performance measures within the spatial and spatial/temporal motor tasks? The strongest relationships among motor tasks are between earlytrial and latertrial performance stages of the same motor task.

Subproblem 2. What are the relationships among the earlytrial and latertrial performance measures between the spatial and spatial/temporal motor tasks? When comparing stages of performance across motor tasks with different spatial/temporal environmental demands, the highest relationship exists between later stages of performance of both tasks. Early and later stages of performance of alternate tasks have low common variability, while early performance on both tasks have almost no common variability. This is the case for both the spatial (nonball) and spatial/temporal (ball) tasks.

Subproblem 3. What are the relationships among field dependence/independence, coincidence anticipation, perceptual speed, peripheral range, and spatial relations? The only significant correlation among coincidence anticipation, field dependence/independence, perceptual speed, peripheral range, and spatial relations is between perceptual speed and spatial relations. This supports the relationships reflected by most of the related literature.

Subproblem 4. What is the relationship of coincidence anticipation, field dependence/independence, perceptual speed, peripheral range, and spatial relations to the earlytrial and latertrial performance measure of the spatial motor and spatial/temporal motor task? No visual perceptual attribute is significantly correlated to a stage of performance of either gross motor task with $p \leq .05$.

Subproblem 5. What underlying factors are suggested by the multivariate analysis of coincidence anticipation, field dependence/independence, perceptual speed, peripheral range, spatial relations, and the earlytrial and latertrial performance measures of both the spatial and spatial/temporal motor tasks? The five underlying factors resulting from the multivariate analysis of the nine variables in this study are: (a) Factor I--ability to perform the spatial/temporal motor task, (b) Factor II--ability to extract and quickly relate pertinent environmental information, (c) Factor III--ability to relate to the total environment and perform the spatial motor task, (d) Factor IV--ability to anticipate coincidence of events at relatively low speeds, and (e) Factor V--ability to detect motion peripherally. Significant interfactor correlations of Factor I with IV and II and Factor III with V demonstrate the relationship of different visual perceptual strategies and gross motor tasks with different environmental demands.

In summary, the research permits the following generalizations. During early learning of a motor task with spatial demands abilities appear to be more related to deriving information concerning the environment into which the body is moving. With respect to the learning of a motor task with spatial and temporal demands, abilities appear to be more related to deriving information concerning the moving object. That is to say, field dependence and wide peripheral range relate to skillful early performance of a spatial motor task. Accurate coincidence anticipation and quick extraction and interrelating of pertinent environmental information relate to skillful early execution of a spatial/temporal motor task.

Implications for Future Research

Within education in the past two decades two important constructs have been identified which enhance the potential to understand learning: (a) information processing offers a theoretical framework for explaining the complexity of processing between stimulus and response, and (b) individual differences in aptitude are recognized as important to learning and as factors which often interact with instructional treatment variations (Snow, 1977). These constructs emphasize the need to use and/or combine experimental and differential research techniques (Fleishman, 1967 and Snow, 1977). Snow (1977) presents components of instructional theory which are worthy of consideration by skill acquisition theorists.

The following suggestions for future research in motor skill acquisition derive from this study and complement Snow's (1977) ideas.

1. Continue to determine multivariate relationships and/or differences among motor tasks and abilities that are theoretically important to skill acquisition and which can be identified with information processing models. Modify and/or add to the information processing models of skill acquisition.

2. Conduct more task analyses of specific motor skills. Theoretical evaluation as well as differential research are needed. Add to, modify, and/or support existing motor task taxonomies.

3. Develop methods/apparatus to measure key abilities (important information processing factors) <u>during the performance</u> of the motor tasks as practice continues.

4. Consider the following factors when designing research projects concerned with skill acquisition: (a) the initial stage of each learner as learning begins, (b) task analysis, and (c) individual differences (abilities) related to task demands.

5. Determine what individual difference variables can be manipulated by varying treatment and/or task conditions. Ongoing rigorous inquiry into the above problems may further the status of knowledge about skill acquisition and contribute to theory development.

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APPENDIX A

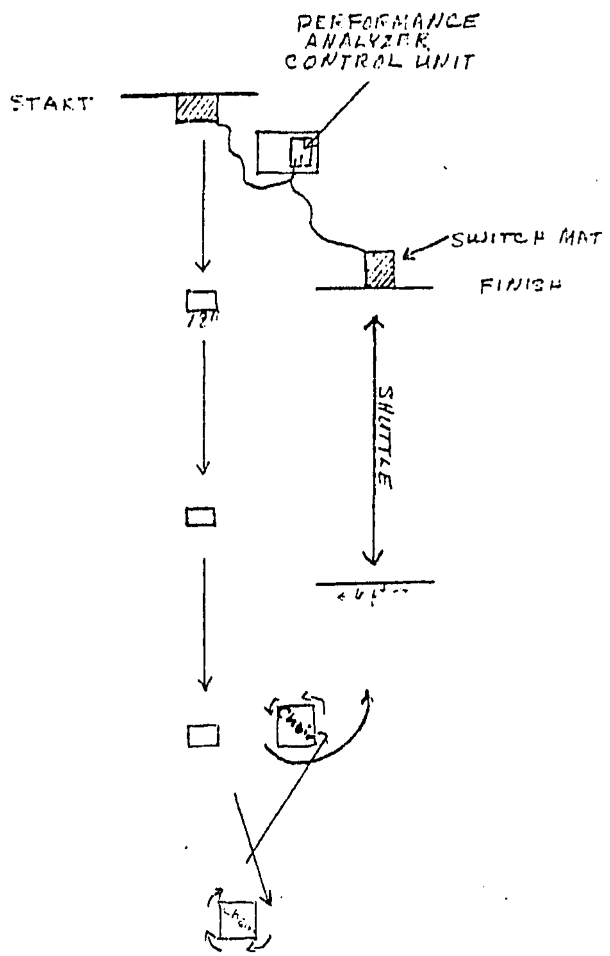
SPATIAL AND SPATIAL/TEMPORAL MOTOR TASKS

PLEASE NOTE:

Some pages have small and indistinct print. Filmed as received.

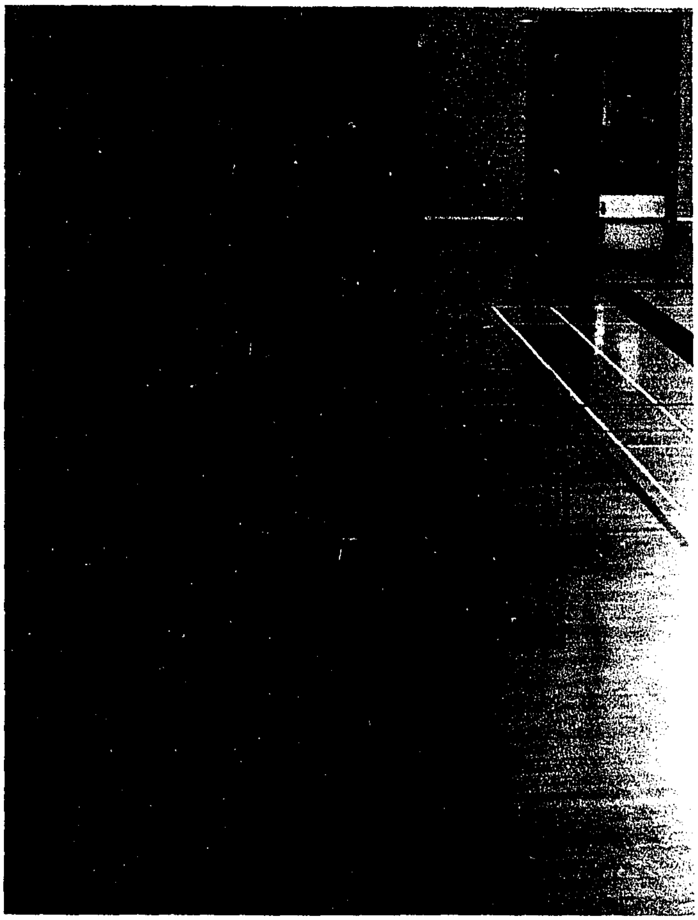
UNIVERSITY MICROFILMS.

Spatial Motor Task Diagram



Testing Environment of the

Spatial Motor Task



Directions for the Spatial Motor Task

The objective of this task is to move as quickly as possible with control through the marked floor pattern. Stand at the blue line; start by stepping on the brown mat; run to the blue rectangle and place both feet simultaneously inside the rectangle; repeat this for the next 2 rectangles; follow the green arrows around the 2 chairs; run to the red line, back to touch the green line, a second time to the red line, and back to the green line; then run across the red line stepping on the brown mat. The score will be the time it takes to complete the task. The timer starts when you step on the first mat and stops when you step on the second mat. You may now walk through the task. (After the Walk)

Do you have any questions?

If you miss a rectangle, land on one foot at a time, go the wrong direction around the chairs, or miss the red or green lines, I will tell you and you will need to go back and complete that part accurately. Therefore, you want to move as quickly as you can, but control your movement during the task.

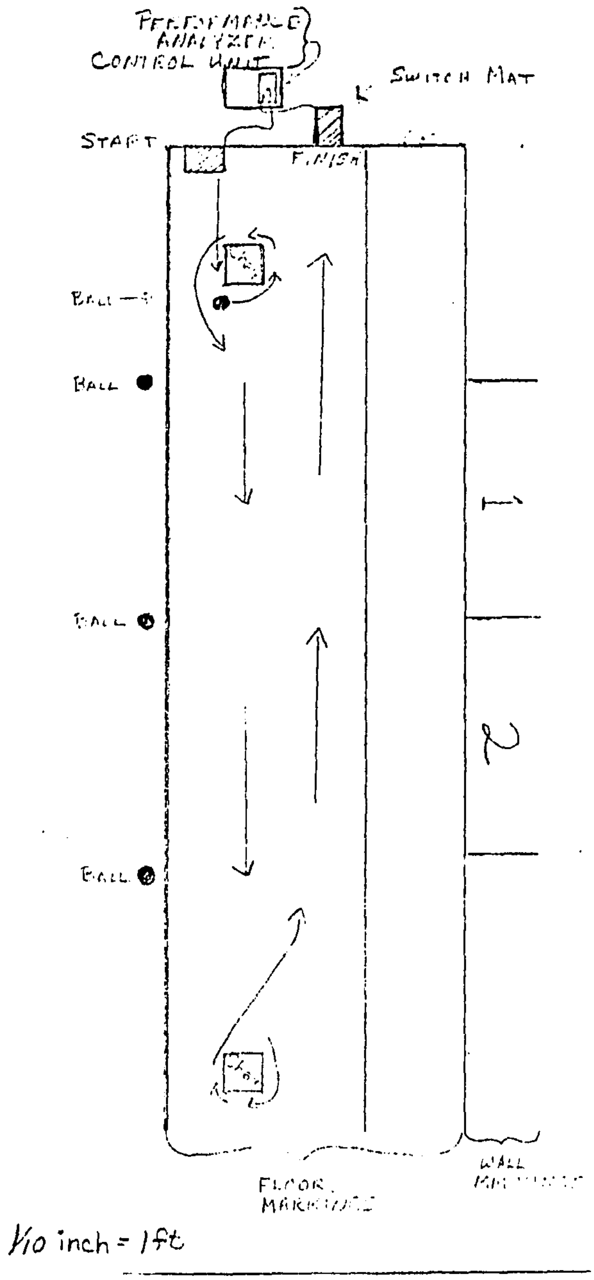
We will follow the order of: first-- , second-- , third-- , and fourth-- . Each time you complete the task check this clock for the position of the minute hand (not the sweep hand). You will have a 3 minute rest period timed by you. After checking the clock, come to the table and check your trial score(s). Please do not discuss your time or your strategy with anyone. The objective over the six trials will be to reduce the time but maintain the control. Please notify me after your 3 minutes of rest. Any further questions?

Encourage them to be up at the line and ready at the end of the rest period. Also, if necessary, encourage not taking long pauses before starting themselves. But, they must start from a standing position.

Record 1 to the left of the score box if these trials are taken the first half of the hour and a 2 if the trials are the second half of the hour. Circle the 1 or 2 at the top of the page. Record the score to the nearest hundredth of a second.

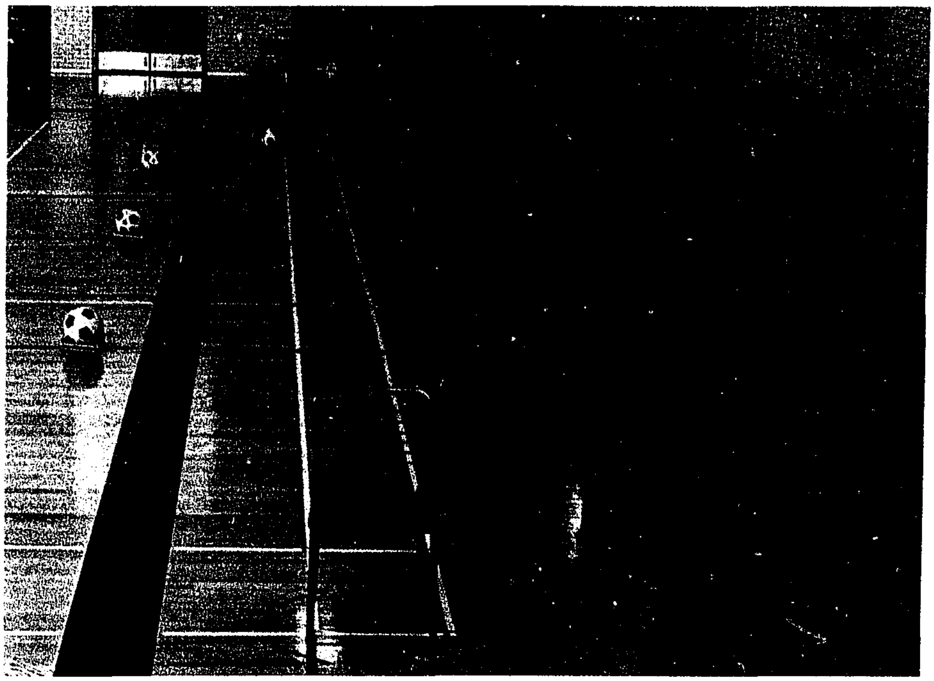
DO NOT RESET the clock if it is running. Use the floor mat to stop the clock, or pull the plug.

Spatial/temporal Motor Task Diagram



Testing Environment of the

Spatial/temporal Motor Task



Directions for the Spatial/temporal Motor Task

The objective of this task is to control the soccer ball with your feet while moving yourself through the marked pattern as quickly as possible. Stand at the red line; step on the brown mat; moving the ball follow the red arrows around the chair; from behind the blue restraining line, kick the ball against section #1 on the wall, then against section #2 on the wall; follow the red arrows around the second chair; kick the ball against section #2, then section #1; and then the ball must cross the start-finish line between the wall and the black line and you must run across the green line stepping on the brown mat. The timer will start when you step on the first mat and will stop when you step on the second mat. The score is the time to complete the task. You may now walk through the task without the ball. Do you have any questions?

During the task if the ball gets away from you and crosses the wide black line, you may take any one of the extra balls and proceed to the next section of the task. However, you may not touch any of the balls with your hands. If the ball is slow to rebound from the wall, you may cross the blue restraining line to bring it back out, but you may not touch the ball with your hands and you must kick it from outside the blue line prior to the ball contacting the wall. If some part of the sequence is missed or inaccurate, I will tell you and you will need to come back and complete it. Therefore, you want to move as quickly as you can yet control the ball and your movement during the task.

We will follow the order of: first-- , second-- , third-- , and fourth-- . Each time you complete the task check this clock for the position of the minute hand (not the sweep second hand). You will have a 3 minute rest period timed by you. Just before your next trial come to the table and check your trial score(s). Please do not discuss your time or your strategy with anyone now or during the week. The objective over the six trials will be to reduce the time but maintain the control. Please notify me after your 3 minutes of rest. Any further questions?

Encourage them to be up at the line and ready at the end of the rest period. Also, if necessary, encourage not taking long pauses before starting themselves. But, they must start from a standing position. You might need to encourage ball retrieval during the rest period depending upon the skill of the group.

Record a 1 to the left of the score box if these trials are taken the first half of the hour and a 2 if the trials are the second half of the hour. Circle the 1 or 2 at the top of the page. Record the score to the nearest hundredth of a second. DO NOT RESET the clock if it is running. Use the floor mat to stop the clock, or pull the plug.

Score Sheet for the Motor Tasks

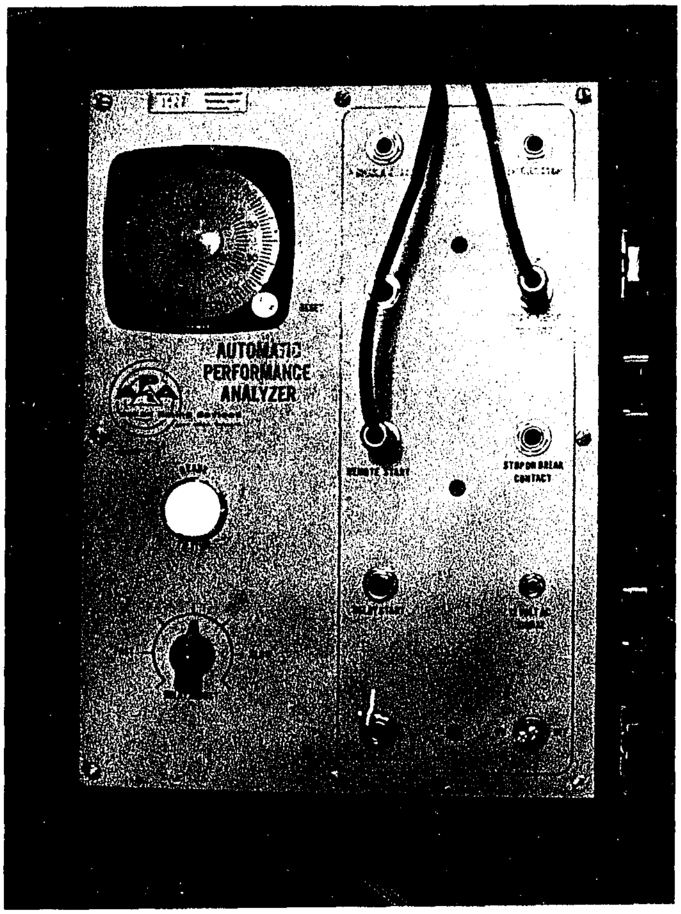
FIRST DAY

SPATIAL TASK				SPATIAL/TEMPORAL TASK			
Trial #	Score	Trial #	Score	Trial #	Score	Trial #	Score
1		2		1		2	
3		4		3		4	
5		6		5		6	
Total	_______		_______	Total	_______		_______
Mean	_______		_______	Mean	_______		_______
Total 1st 3	_______			Total 1st 3	_______		
Mean 1st 3	_______			Mean 1st 3	_______		

SECOND DAY

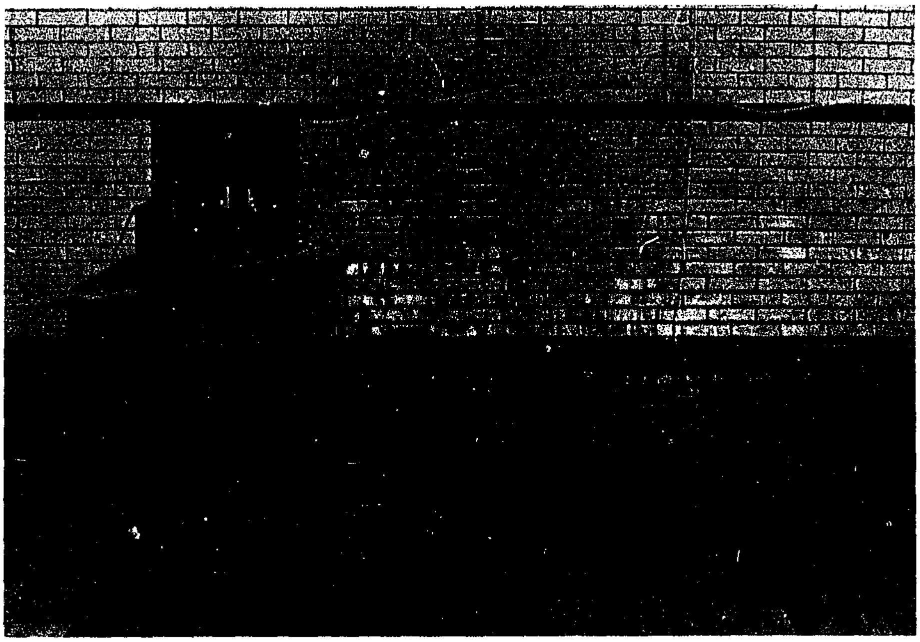
Trial #	Score	Trial #	Score	Trial #	Score	Trial #	Score
7		8		7		8	
9		10		9		10	
11		12		11		12	
Total	_______		_______	Total	_______		_______
Mean	_______		_______	Mean	_______		_______
Total best 3	_______			Total best 3	_______		
Mean best 3	_______			Mean best 3	_______		

Performance Analyzer Control Unit



Performance Analyzer

Control Unit and Switch Mats



APPENDIX B

PERCEPTUAL TASKS

Overall Procedures for Perceptual Tasks

To: Administrators

From: Pat

Re: Overall Procedures for Perceptual Tasks

Attached is a copy of the letter and consent form that each subject has received so that you may be aware of what they know prior to the first tasks.

Procedures with the Subjects:

A. Each time you meet a subject would you
   1. introduce yourself and explain that you are administering the tasks to help me,
   2. thank them for coming,
   3. use their name in talking with them,
   4. try to help them be relaxed, and
   5. explain the overall procedure of the day--e.g. two tasks or three tasks, but no real details.

B. As you begin each task please explain to the subject
   1. there are no value judgements placed on their scores,
   2. some of the items/aspects of the task will be more difficult than others, (for DAT and EFT) also indicate not to be discouraged if there are parts of the task they cannot complete,
   3. ONLY if questioned about wanting scores--indicate that they may know their individual task scores on all tasks at the conclusion of all the tasks including the physical tasks. (This information is in their letter.)

C. Please do not
   1. tell any subject a specific score for a trial or for a task, and
   2. provide motivation except to indicate they are doing fine--whether their times are fast or slow or degrees high or low.

D. Beware of body language during scoring, e.g. extra big grins sometimes, frowning for any reason, signs of surprise or shock. Try to maintain a consistent relaxed and friendly atmosphere by voice quality and manner.

E. At the completion of the day's tasks please tell the subjects thanks for coming and thanks for their help.

Procedures at Beginning and Completion of the hour:

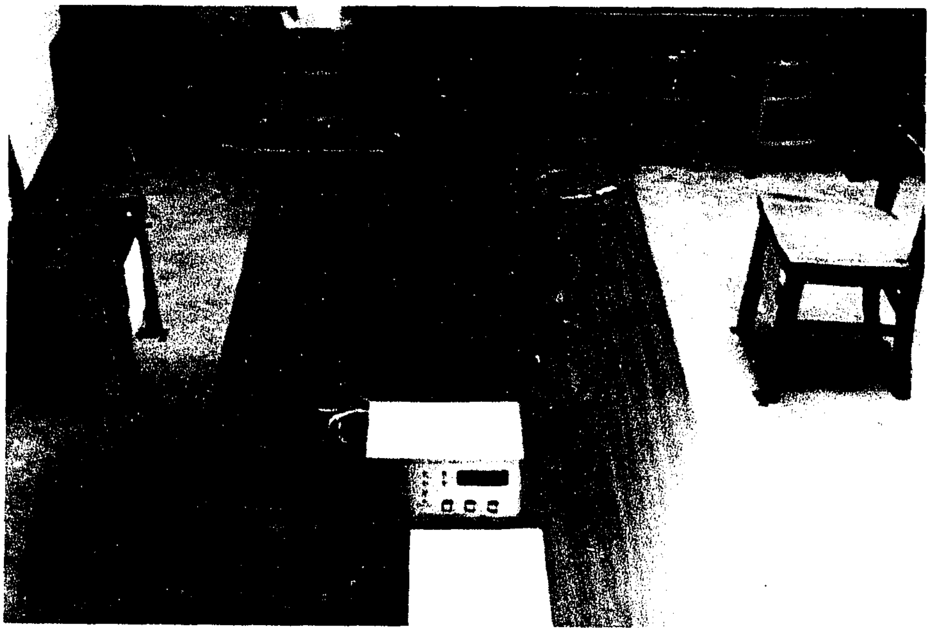
A. Beginning
   1. check PROTOCOL Box,
   2. take score sheets--check day and time and subject's name,
   3. note order of tasks,
   4. begin Procedures with Subjects.

B. Completion
   1. initial the scoresheet at Administrator
   2. place scoresheet <u>upside down</u> in COMPLETED Box.
   3. help move furniture if a change of EFT-Bassin-Periom/ DAT-RFT is needed.

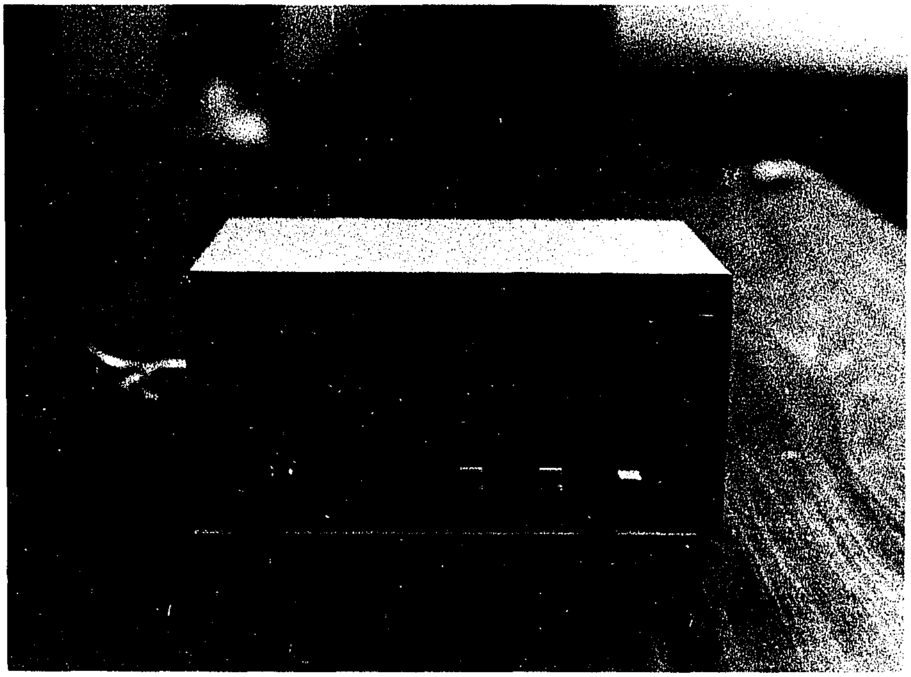
Your assistance in collecting data and helping to maintain a consistent friendly atmosphere with all subjects is most appreciated. I certainly would not be able to do this study without your help. THANK YOU!

Testing Environment of the

Bassin Timer Task



Bassin Timer Control Unit



Randomly Determined Bassin Timer Presentation Order

Trial #	Side	Speed	Trial #	Side	Speed
1	R	M	19	R	M
2*	L	M	20*	L	F
3	R	F	21	L	S
4*	L	S	22*	R	S
5	L	M	23	L	S
6*	R	S	24*	R	F
7	L	F	25	R	S
8*	L	F	26*	L	F
9	L	F	27	R	S
10*	R	F	28*	R	M
11	L	M	29	R	S
12*	R	M	30*	L	S
13	L	M	31	R	S
14*	R	F	32*	L	S
15	R	F	33	L	M
16*	R	S	34*	L	M
17	L	F	35	R	F
18*	R	M	36*	R	M

L = left   F = fast = 4 m.p.h.
R = right   M = medium = 3 m.p.h.
            S = slow = 2 m.p.h.

*Alternate Set

Directions for the Bassin Timer Task

The subject is seated in chair #1 which is centered 3 feet from the last light on the Bassin Timer and the track approaching from the subject's left. The subject is given a remote control switch and told:

Hold this switch in your preferred hand with your thumb touching the button.

The objective of this task is to press the button with your thumb exactly as the last bulb on this track lights. There will be different speeds of lights during the different trials. Let us take a few practice trials. I will say "Ready," the yellow warning light will come on, and then the bulbs on the track will light sequentially. Try to anticipate the arrival of the lights at the last bulb, and press the button. Keep your thumb lightly on the button at all times.

Ready (practice trial 1 activated -- comment on procedure -- complete practice trials 2 and 3 from the left side --).

Take the control button and move to chair #2. (do 3 more practice trials)

Before each trial I will indicate the chair number, be sure you are in the correct place when I say Ready. Do you have any questions before we begin?

Watch the subjects thumb--be sure she keeps it on the button. The response light will be on if the subject is holding the button too tight. Record the direction of the response in the DIR. column. If early, record a +, if late, record a -. Record the TIME in milliseconds.

Score Sheet for the Bassin Timer Task

Tr.#	Chair #	Speed	Dir.	Time	1,000	Adj. Sc.	Tr.#	Chair #	Speed	Dir.	Time	1,000	Adj. Sc.
1	2	3					2	1	3				
3	2	4					4	1	2				
5	1	3					6	2	2				
7	1	4					8	1	4				
9	1	4					10	2	4				
11	1	3					12	2	3				
13	1	3					14	2	4				
15	2	4					16	2	2				
17	1	4					18	2	3				
19	2	3					20	1	4				
21	1	2					22	2	2				
23	1	2					24	2	4				
25	2	2					26	1	4				
27	2	2					28	2	3				
29	2	2					30	1	2				
31	2	2					32	1	2				
33	1	3					34	1	3				
35	2	4					36	2	3				
TOTAL						Set #1_____							Set #2_____
MEAN						_____							_____

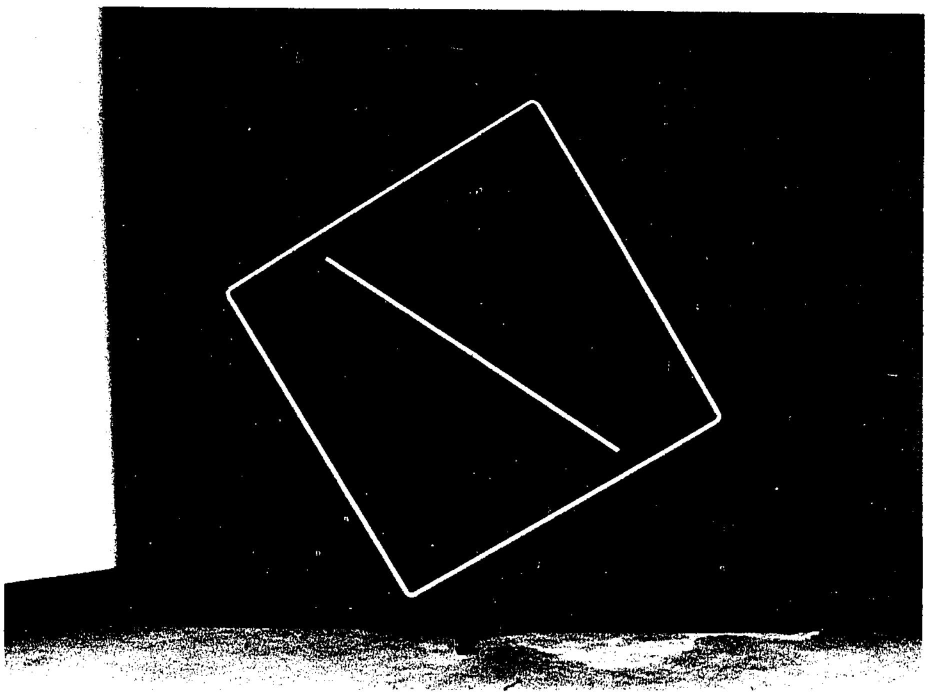
GT__________

GM__________

Practice Trials

T1	1	2	T2	1	3	T3	1	4
T4	2	4	T5	2	3	T6	2	2

Rod-and-Frame Apparatus



Subject Position

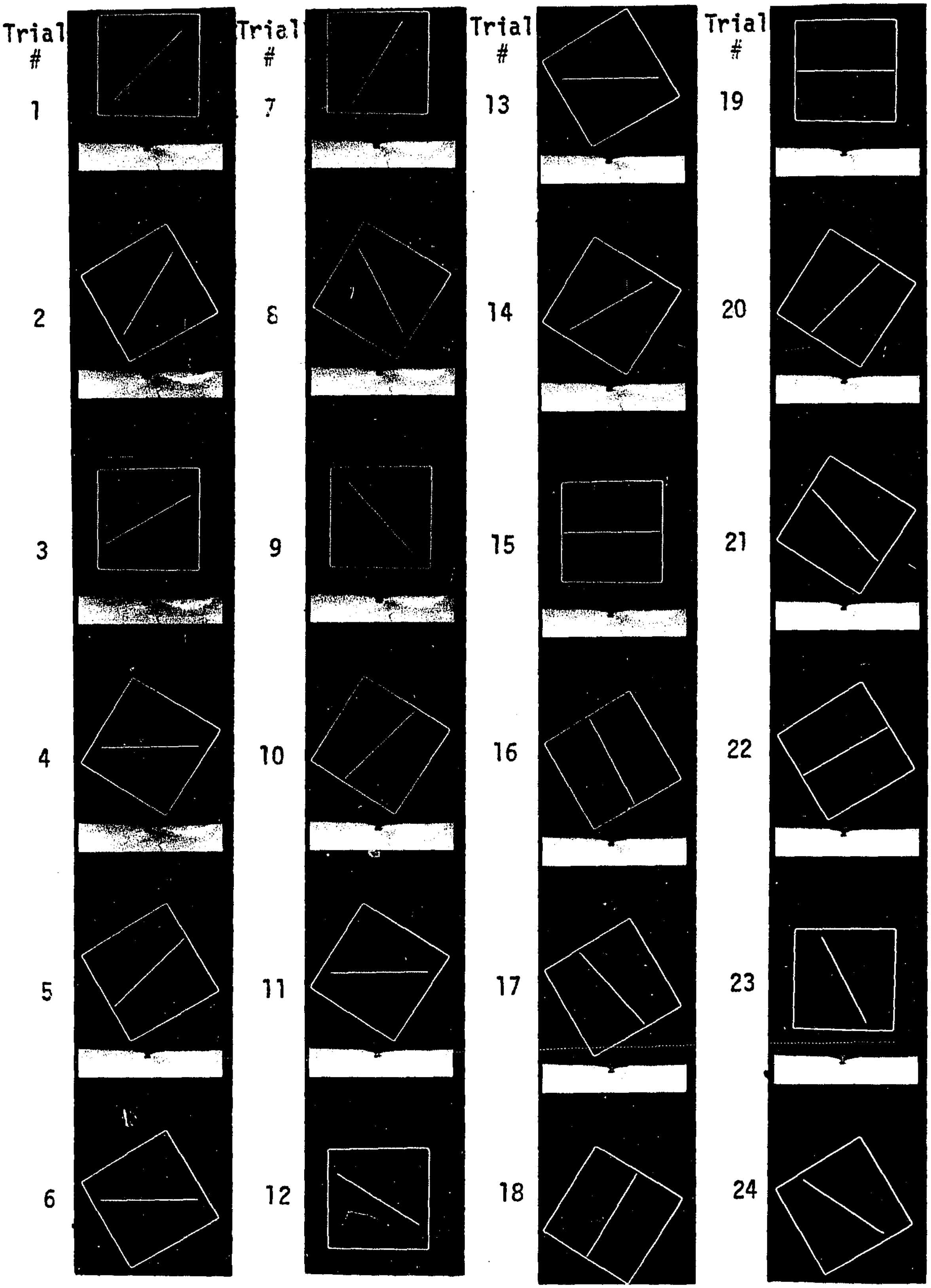
and

Rod-and-Frame Remote Control Unit

Randomly Determined Rod-and-Frame Presentation Order

Trial #	Frame	Rod	Trial #	Frame	Rod
1	0	315	12	332	300
2	28	330	13	0	90
3	0	300	14	28	30
4	332	90	15	28	45
5	28	315	16	332	330
6	0	330	17	332	60
7	332	30	18	332	45
8	0	45	19	28	300
9	332	315	20	0	30
10	0	60	21	28	60
11	28	90			

Rod-and-Frame Positions



Directions for the Rod-and-Frame Test

The subject is blindfolded with dark goggles and brought into the test room four minutes prior to the test. The subject is seated in a chair 18 feet from the rod-and-frame. The subject remains blindfolded during the explanations of the test. The remote control switch is fastened in the arm of chair and the subject's preferred hand is placed on the switch.

When your blindfold is removed you will see two illuminated figures, a rod and a frame. Moving the switch on the control box will cause the rod to turn in either direction. (Turn out the light and then say) Remove your blindfold and you may practice with the control switch.

(Allow 30 seconds of Practice.)

During this task you will be presented with a series of positions of the rod. Following the cue "Ready" you are to remove your blindfold and move the rod to a vertical position using the control switch. When you are satisfied with the position put your blindfold on again and say "OK". Do you have any questions?

Let us go through a practice trial; replace your blindfold, (rod set at 20^{o}, frame at 0^{o}). "Ready" (pause and add) "Now you may remove your blindfold and move the rod until it is vertical." "Tell me when you are ready and have replaced your blindfold." Do you have any further questions? We will begin.

Be sure the flashlight is out when you say Ready. Remind them to replace the blindfold the first several trials. Record the DEGREES indicated. Record the direction of the response in the DIR. column:

+ = overestimating--going past 0 pt. at least once
- = underestimating--not reaching 0 pt.

Score Sheet for the Rod-and-Frame Test

ROD-AND-FRAME TEST

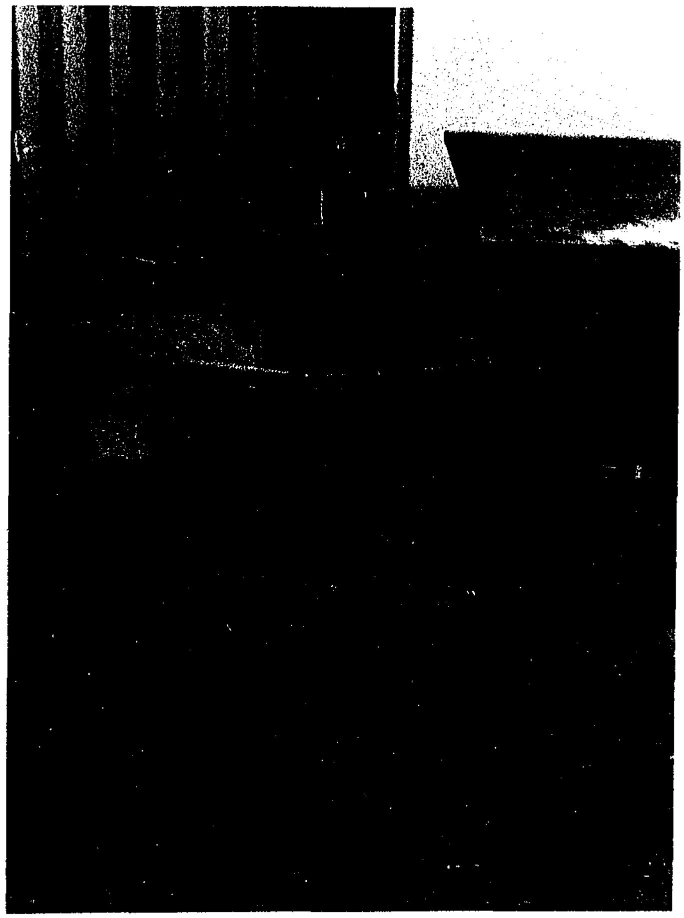
Tr. #	Frame	Rod	Degrees	Dir.	Tr. #	Frame	Rod	Degrees	Dir.
1	0	315			2	28	330		
3	0	300			4	332	90		
5	28	315			6	28	270		
7	0	330			8	332	30		
9	0	45			10	332	315		
11	332	270			12	0	60		
13	28	90			14	332	300		
15	0	90			16	28	30		
17	28	45			18	332	330		
19	0	270			20	332	315		
21	332	45			22	28	300		
23	0	30			24	28	60		

______ TOTAL ______ MEAN ODD ______ TOTAL ______ MEAN EVEN

Administrator______________ ______________ GRAND TOTAL ______________ GRAND MEAN

Testing Environment of the

Embedded Figures Test



Directions for the Embedded Figures Test

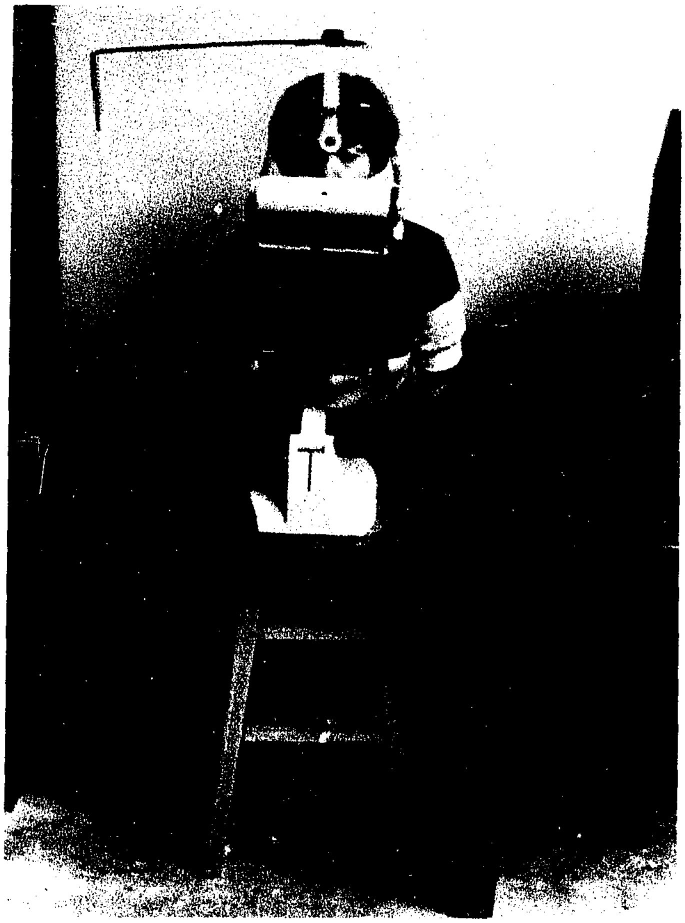
I am going to show you a series of colored designs. Each time I show you one, I want you to describe it in any way you wish. I will then show you a Simple Form which is contained in that larger design. You will then be given the larger design, and your job will be to locate the Simple Form in it. Let us go through a practice trial to show you how it is done. (Show practice complex -- 15 sec. -- and simple -- 10 sec.)

I will now show you the colored design again, and you are to find the Simple Form in it. As soon as you have found the Simple Form let me know, and start tracing the Simple Form with the stylus. When you are tracing, do not let the stylus touch the surface of the card. (Show complex form and begin timing.)

This is how we will proceed on all trials. In every case the Simple Form will be present in the larger design. It will always be in the upright position, so <u>don't</u> turn the card around. There may be several of the Simple Forms in the same design, but you are to find and trace only one. Work as quickly as you possibly can, since I will be timing you, but be sure that the form you find is exactly the same as the original Simple Form in <u>shape</u>, <u>size</u>, and <u>proportions</u>. As soon as you have found the form, tell me at once and then start to trace it. If you ever forget what the Simple Form looks like, you may ask to see it again, and you may do so as often as you like. The timer will be stopped during the period the Simple Figure is exposed and you have a maximum of 10 seconds (count to yourself 1001, 1002, etc.) each time you ask to see the Simple Form. Are there any questions?

Testing Environment of the

Periometer Task



Directions for the Perimeter Task

The instrument is positioned so that the forehead rest is the height of the subject's forehead. The examiner stands in front of the subject, close enough to reach the control knob and watch the subject's eye focus. The knob controlling the target should be firmly grasped by the examiner so that she can move the target without giving arm movement clues to the subject.

The objective of this task is to notify me as soon as you see the target on either your right or left side. If you wear your glasses while playing, please wear them during this test. Place your head against this rest (point to the head rest). Now look at this white spot, keep your eyes focused on it, and do not look away from the spot after I say "Ready" (point to white spot during this). When you see this target come into view say "STOP" as quickly as possible. Do you have any questions?

Be sure to look at this white spot all the time. Ready?

The examiner swings the target behind the subject's head out of range of vision. Then slowly advance the target to the right or left as indicated on the score sheet, until the subject first detects the presence of the moving target. When the subject says "STOP", read the dial, and record the score. Repeat until all trials have been scored. If the subject moves her eyes from the fixation point during a trial, disregard the reading on that trial. Remind the subject of the focus point and repeat the missed trial. Keep the score sheet covered or out of sight of the subject: Record the score to the preceding 5 degrees in the DEGREES column.

*Slowly = 90° in 5 sec

Score Sheet for the Periometer Task

PERIOMETER

Trial #	Side	Degrees	Trial #	Side	Degrees
1	R		2	R	
3	L		4	L	
5	R		6	L	
7	R		8	R	
9	L		10	L	
11	L		12	R	

ODD TOTAL__________ EVEN TOTAL__________

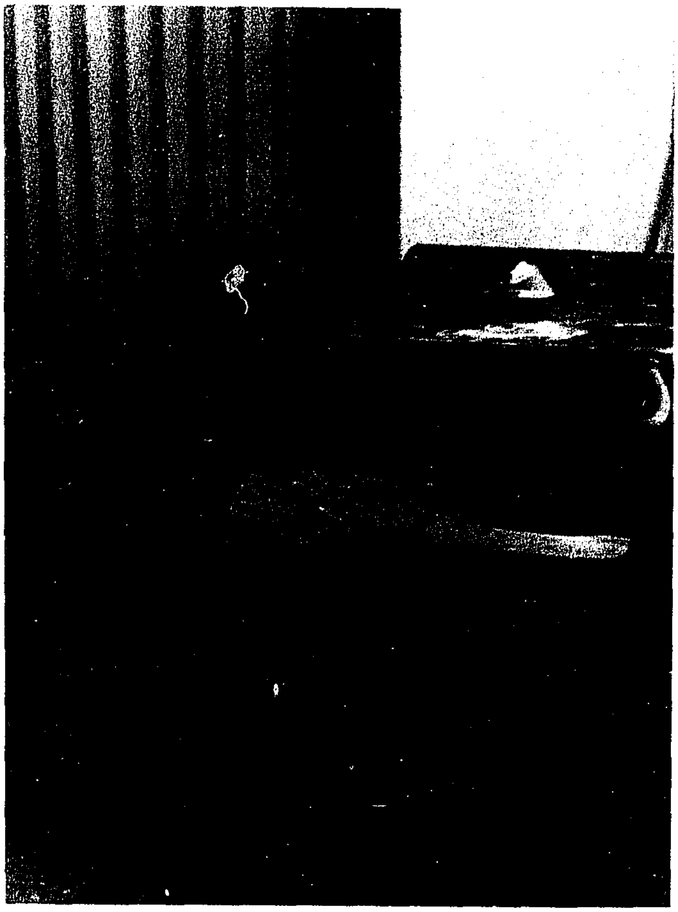
MEAN __________ MEAN __________

GRAND TOTAL ____________

GRAND X ________________

Test Environment of the

Differential Aptitudes Space Relations Test



Directions for the Differential Aptitudes

Space Relations Test

After the RFT subject is blindfolded and taken inside, the DAT subject is seated outside Room 2 with test booklet, answer sheet, and pencil. The kitchen timer is placed just inside the door. The subject is asked to read the 2 pages of instructions and examples. After the subject reads the instructions, say:

You will have 25 minutes to complete as many items as you can, some are easier, others more difficult. If you cannot answer an item, leave it blank and go on. Mark the answer sheet by writing the letter (a, b, c, d) of the figure you believe to be correct. The timer will ring once to give you a 1 minute warning. When it rings the second time, put your pencil down and slide your answer sheet under the door. Do you have any questions?

If person is taking the DAT first, remind her to stay to take the Rod-and-Frame test.

Score Sheet for the Differential Apptitudes

Space Relations Test

DAT--SPACE RELATIONS TEST

1.____	16.____	31.____	46.____
2.____	17.____	32.____	47.____
3.____	18.____	33.____	48.____
4.____	19.____	34.____	49.____
5.____	20.____	35.____	50.____
6.____	21.____	36.____	51.____
7.____	22.____	37.____	52.____
8.____	23.____	38.____	53.____
9.____	24.____	39.____	54.____
10.____	25.____	40.____	55.____
11.____	26.____	41.____	56.____
12.____	27.____	42.____	57.____
13.____	28.____	43.____	58.____
14.____	29.____	44.____	59.____
15.____	30.____	45.____	60.____

ODD TOTAL________ ________ # correct

EVEN TOTAL________ ________ # wrong

Administrator__________________

APPENDIX C

LETTER TO SUBJECTS

AND

INFORMED CONSENT

March, 1977

Dear

You have been specially selected to participate in a study concerned with the relationship of visual perception and practice trials of two physical tasks of college women. The study is directed by Pat Beitel and is a part of her doctoral dissertation.

Your scores are considered confidential information. Following the completion of the perceptual and physical tasks names are to be removed from all score sheets. At the conclusion of the testing you may see your scores on all tasks if you request it.

This study can only be accomplished with your help. Your contribution is very important. You are doing a real favor if you agree to participate and you may withdraw at anytime.

If you are willing to participate you are asked to give a maximum of one hour a week March 21-25 and March 28 - April 1 to complete the 5 perceptual tasks. Then the week of April 4-7 you are asked to complete the practice trials of the two physical skills taking a maximum of 1 hour on 2 alternate days either Mon. and Wed. or Tues. and Thurs. The total commitment is a maximum of 4 hours spread across the next 3 weeks.

Please fill out the attached forms and sign up on the master schedule for times you can come. Come to Room 2 in Rosenthal for the perceptual tasks during the first two weeks, and come to Coleman Gym 210 for the physical tasks for the third week, April 4-7.

Thank you very much for your assistance.

Sincerely,

Patricia A. Beitel
292-8209 Home Phone
Coleman Gym Mailbox

March 21-25		March 28 - April 1		April 4-7	
Day	Time	Day	Time	Days	Time
M T W Th F	________	M T W Th F	________	M-W T-Th	________
		Rosenthal Room 2		Coleman Gym 210	

INFORMED CONSENT*

I understand that the purpose of this study is to learn more about beginning practice of physical tasks and the relationship of visual perception.

I confirm that my participation as a subject is entirely voluntary. No coercion of any kind has been used to obtain my cooperation.

I understand that I may withdraw my consent and terminate my participation at any time during the investigation.

I have been informed of the procedures that will be used in the study and understand what will be required of me as a subject.

I understand that all of my responses and sources will remain completely anonymous.

I wish to give my cooperation as a subject.

Signed______________________________

*Adapted from Locke and Spirduso (1976)

____

Activity class spring, 1977______________________________
Day___________________ Time___________________

Campus address____
Phone____________________

Do you have any physical limitations? yes no
If yes, please describe_____________________________________

Do you wear glasses? yes no During physical activity? yes no
Reading? yes no

Do you wear contacts? yes no During physical activity? yes no
Reading? yes no

Other explanation____

March 21-25		March 28 - April 1		April 4-7	
Day	Time	Day	Time	Days	Time
M T W Th F	________	M T W Th F	_________	M-W T-Th	________

APPENDIX D

RAW DATA AND STANDARDIZED SCORES

Raw Data and Standardized Scores

	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
01	1.58	53	1.025	90.00	14	17.83	16.34	29.86	22.56
	-0.37	1.59	-0.40	0.65	-1.39	-0.76	-0.62	-0.31	-0.39
02	1.62	46	.998	68.75	26	25.08	26.47	26.44	27.69
	-0.36	0.87	-0.92	-1.27	-0.82	3.17	3.13	-0.90	1.08
03	1.79	45	1.060	70.83	20	16.89	15.15	27.07	19.33
	-0.33	0.76	0.27	-1.09	-1.10	-1.26	-1.49	-0.79	-1.31
04	30.00	29	1.063	91.67	71	19.38	17.73	42.19	27.02
	4.40	-0.89	0.33	0.80	1.32	0.08	0.40	1.82	0.89
05	1.50	33	1.012	83.33	45	17.38	16.54	30.99	25.56
	-0.38	-0.47	-0.65	-0.05	0.09	-1.00	-0.47	-0.11	0.47
06	0.46	49	1.016	95.00	26	18.83	14.71	21.35	18.60
	-0.55	1.18	-0.58	1.10	-0.82	-0.21	-1.81	-1.78	-1.52
07	3.04	28	1.028	90.00	52	20.20	18.37	36.84	28.63
	-0.12	-0.99	-0.35	0.65	0.42	0.53	0.86	0.90	1.35
08	5.17	33	1.132	63.33	52	19.65	17.20	35.89	25.53
	0.24	-0.47	1.65	-1.77	0.42	0.23	0.01	0.73	0.46

ID	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
09	1.17	30	0.990	85.83	13	20.34	18.07	35.72	27.61
	-0.44	-0.78	-1.08	0.27	-1.43	0.60	0.64	0.70	1.06
10	3.29	22	1.103	67.08	88	22.46	19.44	36.19	29.84
	-0.08	-1.61	1.10	-1.43	2.13	1.75	1.64	0.79	1.70
11	1.00	35	1.108	91.67	40	18.53	17.48	28.41	26.31
	-0.46	-0.27	1.19	0.80	-0.15	-0.38	0.21	-0.56	0.69
12	22.38	43	1.128	76.25	44	17.36	15.55	32.15	23.93
	3.12	0.56	1.58	-0.59	0.04	-1.01	-1.19	0.09	0.00
13	0.71	16	1.041	87.08	34	20.73	18.43	26.42	23.29
	-0.51	-2.23	-0.96	0.39	-0.44	0.81	0.91	-0.90	-0.18
14	1.25	35	1.159	78.75	53	19.27	18.60	35.14	28.51
	-0.42	-0.27	2.17	-0.37	0.47	0.02	1.03	0.60	1.32
15	0.46	19	1.031	93.33	61	19.22	16.12	30.29	20.05
	-0.55	-1.92	-0.29	0.95	0.85	-0.00	-0.78	-0.24	-1.11
16	0.62	32	0.997	79.58	52	19.06	16.13	33.48	21.95
	-0.58	-0.58	-0.94	-0.29	0.42	-0.09	-0.77	0.32	-0.56

ID	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
17	0.92	38	1.020	84.17	28	17.76	15.79	28.10	22.62
	-0.48	0.04	-0.50	0.12	-0.72	-0.79	-1.02	-0.61	-0.37
18	1.21	43	1.026	88.33	49	18.38	17.49	34.12	22.55
	-0.43	0.56	-0.38	0.50	0.28	-0.46	0.22	0.43	-0.39
19	2.79	35	1.067	62.50	64	21.54	18.81	31.37	27.40
	-0.16	-0.27	0.40	-1.84	0.99	1.25	1.18	-0.05	1.00
20	1.21	33	0.961	90.00	33	27.03	15.01	24.76	19.53
	-0.43	-0.47	-1.63	0.65	-0.48	4.22	-1.59	-1.19	-1.26
21	1.33	36	1.012	90.00	39	17.20	15.71	28.17	21.64
	-0.41	-0.16	-0.65	0.65	-0.20	-1.10	-1.08	-0.60	-0.65
22	2.29	37	1.071	67.92	70	20.07	18.14	38.91	28.05
	-0.25	-0.06	0.48	-1.35	1.27	0.46	0.70	1.26	1.19
23	3.08	29	0.983	75.83	31	19.23	18.27	37.18	26.02
	-0.12	-0.89	-1.21	-0.63	-0.58	0.00	0.79	0.96	0.60
24	0.83	36	0.936	60.00	29	17.50	16.74	45.77	23.04
	-0.49	-0.16	-2.12	-2.07	-0.67	-0.94	-0.33	2.44	-0.25

	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
25	23.12 3.25	27 -1.09	0.973 -1.40	94.17 1.03	37 -0.29	16.63 -1.41	15.82 -1.00	28.62 -0.52	20.50 -0.98
26	0.50 -0.55	56 1.90	1.058 0.23	61.67 -1.92	27 -0.77	19.11 -0.06	16.21 -0.71	27.60 -0.70	20.50 -0.98
27	21.62 3.00	29 -0.89	0.951 -1.83	86.25 0.31	51 0.37	16.56 -1.44	15.27 -1.40	32.26 0.10	26.98 0.88
28	5.88 0.35	25 -1.30	1.040 -0.12	63.75 -1.73	48 0.23	17.49 -0.94	15.57 -1.18	26.13 -0.96	25.61 0.49
29	1.46 -0.39	55 1.80	1.028 -0.35	59.17 -2.14	25 -0.86	20.01 0.42	17.89 0.51	25.51 -1.06	22.03 -0.54
30	2.42 -0.23	34 -0.37	1.036 -0.19	85.42 0.24	72 1.37	18.44 -0.43	17.31 0.09	31.11 -0.09	23.45 -0.13
31	2.54 -0.20	41 0.35	1.032 -0.27	100.00 1.56	32 -0.53	19.18 -0.02	17.35 0.12	40.27 1.49	25.84 0.55
32	1.33 -0.41	39 0.14	0.995 -0.98	92.92 0.92	61 0.85	19.24 0.01	17.55 0.26	29.36 -0.40	20.92 -0.86

ID	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
33	2.38	31	1.014	89.17	48	19.35	17.29	32.02	25.13
	-0.23	-0.68	-0.62	0.58	0.23	0.07	0.08	0.06	0.35
34	1.12	38	1.130	92.50	25	23.01	20.73	40.55	29.77
	-0.44	0.04	1.62	0.88	-0.86	2.05	2.59	1.54	1.68
35	1.33	31	0.988	78.33	39	17.10	16.31	26.36	21.66
	-0.41	-0.68	-1.12	-0.41	-0.20	-1.15	-0.64	-0.92	-0.64
36	6.00	37	1.058	82.50	52	19.35	17.49	28.43	23.08
	0.37	-0.06	0.23	-0.03	0.42	0.07	0.22	-0.56	-0.24
37	1.54	40	1.045	73.33	13	20.32	16.62	32.18	22.88
	-0.37	0.25	-0.02	-0.86	-1.43	0.59	-0.41	0.09	-0.30
38	9.42	36	1.079	83.33	41	21.62	19.02	34.51	33.64
	0.95	-0.16	0.63	0.05	-0.10	1.30	1.34	0.50	2.79
39	1.33	46	1.094	95.00	22	20.48	18.65	35.81	33.28
	-0.41	0.87	0.92	1.10	-1.01	0.68	1.07	0.72	2.69
40	3.12	36	1.171	82.50	42	20.16	18.34	30.37	25.90
	-0.11	-0.16	2.40	-0.03	-0.06	0.51	0.84	-0.22	0.57

ID	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
41	2.46	39	1.021	92.08	100	19.78	17.22	25.87	21.76
	-0.22	0.14	-0.48	0.84	2.70	0.30	0.02	-1.00	-0.62
42	1.21	42	1.044	89.58	27	19.37	17.78	40.17	22.67
	-0.43	0.45	-0.04	0.61	-0.77	0.08	0.43	1.48	-0.36
43	1.08	34	1.101	89.58	15	18.10	17.81	40.08	30.54
	-0.45	-0.37	1.06	0.61	-1.34	-0.61	0.45	1.46	1.90
44	1.83	52	0.993	93.75	75	19.65	18.91	25.33	20.11
	-0.32	1.49	-1.02	0.99	1.51	0.23	1.26	-1.09	-1.09
45	3.00	46	1.091	79.17	39	17.49	15.62	21.34	17.01
	-0.13	0.87	0.86	-0.33	-0.20	-0.94	-1.14	-1.78	-1.98
46	1.08	19	1.000	64.17	92	22.70	18.58	35.23	26.30
	-0.45	-1.92	-0.88	-1.69	2.32	1.88	1.02	0.62	0.69
47	20.88	17	1.077	92.92	69	16.71	15.48	28.72	18.91
	2.87	-2.13	0.60	0.92	1.23	-1.36	-1.25	-0.51	-1.43
48	9.79	44	1.131	84.58	25	20.37	16.22	26.22	20.46
	1.01	0.66	1.63	0.16	-0.86	0.62	-0.71	-0.94	-0.99

ID	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
49	1.29	43	1.024	99.58	46	19.94	16.46	34.28	22.07
	-0.42	0.56	-0.42	1.52	0.13	0.39	-0.53	0.46	-0.53
50	1.96	44	1.056	89.58	66	19.74	20.14	37.09	22.98
	-0.30	0.66	0.19	0.61	1.08	0.28	2.16	0.94	-0.27
51	0.83	30	0.986	78.33	40	18.20	17.23	33.67	22.57
	-0.49	-0.78	-1.15	-0.41	-0.15	-0.56	0.03	0.35	-0.38
52	0.88	50	1.112	94.58	52	18.89	15.61	26.75	20.69
	-0.48	1.28	1.27	1.07	0.42	-0.18	-1.15	-0.85	-0.92
53	0.96	44	1.072	80.83	16	20.85	17.14	32.36	21.86
	-0.47	0.66	0.50	-0.18	-1.29	0.88	-0.03	0.12	-0.59
54	0.92	45	1.036	80.42	20	19.33	16.90	37.66	26.62
	-0.48	0.76	-0.19	-0.22	-1.10	0.06	-0.21	1.04	0.78
55	1.42	50	1.060	92.50	21	18.56	15.76	38.85	28.29
	-0.39	1.28	0.27	0.88	-1.05	-0.36	-1.04	1.25	1.26
56	0.17	52	1.092	94.58	41	17.40	16.04	26.61	21.99
	-0.60	1.49	0.88	1.07	-0.10	-0.99	-0.84	-0.87	-0.55

ID	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
57	2.04 -0.29	45 0.76	1.077 0.60	62.92 -1.80	23 -0.96	20.93 0.92	19.22 1.48	25.84 -1.01	24.61 0.20
58	5.33 0.26	33 -0.47	1.041 -0.10	90.00 0.65	86 2.03	20.53 0.71	17.33 0.10	29.01 -0.46	23.15 -0.22
59	3.12 -0.11	23 -1.51	0.982 -1.23	90.00 0.65	52 0.42	18.43 -0.43	16.87 -0.23	38.26 1.14	22.92 -0.28
60	3.83 0.01	43 0.56	1.008 -0.73	77.92 -0.44	51 0.37	18.80 -0.23	17.42 0.17	22.65 -1.56	18.32 -1.60
61	2.25 -0.25	36 -0.16	1.046 0.00	87.92 0.46	58 0.70	16.96 -1.23	16.66 -0.38	27.08 -0.79	23.14 -0.22
62	1.33 -0.41	51 1.38	1.003 -0.83	90.83 0.73	60 0.80	15.53 -2.00	14.89 -1.68	23.43 -1.42	19.70 -1.21
63	1.58 -0.37	22 -1.61	0.937 -2.10	94.17 1.03	44 0.04	18.54 -0.37	18.33 0.83	39.50 1.36	25.93 0.58
64	1.67 -0.35	50 1.28	1.011 -0.67	80.42 -0.22	16 -1.29	17.98 -0.68	16.08 -0.81	26.53 -0.89	19.01 -1.41

ID	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
65	1.67	47	1.031	82.92	22	21.20	18.14	29.14	21.67
	-0.35	0.97	-0.29	0.01	-1.01	1.07	0.70	-0.43	-0.64
66	1.46	45	1.041	92.08	32	18.56	16.87	20.97	21.61
	-0.39	0.76	-0.10	0.84	-0.53	-0.36	-0.23	-1.85	-0.66
67	0.96	35	1.101	93.33	28	18.29	16.62	34.78	22.56
	-0.47	-0.27	1.06	0.95	-0.72	-0.51	-0.41	0.54	-0.39
68	0.71	31	1.058	80.00	55	17.00	14.73	23.64	17.74
	-0.51	-0.68	0.23	-0.25	0.56	-1.20	-1.79	-1.39	-1.77
69	1.96	32	0.991	82.92	65	17.44	15.17	30.17	27.79
	-0.30	-0.58	-1.06	0.01	1.04	-0.97	-1.48	-0.26	1.11
70	1.71	43	1.119	61.25	29	18.86	17.82	39.45	27.17
	-0.34	0.56	1.40	-1.95	-0.67	-0.20	0.46	1.35	0.93
71	0.67	50	1.070	59.58	19	19.26	17.44	29.83	23.69
	-0.52	1.28	0.46	-2.11	-1.15	0.02	0.18	-0.32	-0.06
72	1.58	36	1.044	82.08	28	17.40	16.68	35.30	23.22
	-0.37	-0.16	-0.04	-0.07	-0.72	-0.99	-0.37	0.63	-0.20

ID	RFT	DAT	BASSIN	PERIOM	EFT	SPATIAL1	SPATIAL2	SPATEMP1	SPATEMP2
73	1.58	49	1.073	85.42	22	20.27	16.81	34.43	24.32
	-0.37	1.18	0.52	0.24	-1.01	0.56	-0.28	0.48	0.12
74	1.75	55	0.966	94.58	12	20.17	18.17	35.36	24.65
	-0.34	1.80	-1.54	1.07	-1.48	0.51	0.72	0.64	0.21
75	12.92	26	1.095	84.58	46	18.82	16.04	24.19	20.19
	1.54	-1.20	0.94	0.16	0.13	-0.22	-0.84	-1.30	-1.07
76	2.79	28	1.128	99.17	84	19.31	18.42	27.54	24.81
	-0.16	-0.99	1.58	1.48	1.94	0.04	0.90	-0.71	0.26
77	1.25	36	1.121	83.75	30	18.54	17.44	31.36	21.55
	-0.42	-0.16	1.44	0.08	-0.63	-0.37	0.18	-0.05	-0.68
78	2.25	27	1.062	65.83	54	20.92	17.91	34.51	27.09
	-0.25	-1.09	0.31	-1.54	0.51	0.92	0.53	0.50	0.91
79	2.17	29	1.001	68.33	91	19.70	18.50	33.22	26.36
	-0.27	-0.89	-0.87	-1.31	2.27	0.26	0.96	0.27	0.70
80	20.12	49	1.096	87.50	35	18.64	17.78	47.68	28.44
	2.74	1.18	0.96	0.42	-0.39	-0.32	0.43	2.78	1.30