1985

The Interaction of Conceptual Tempo and Modeling on Motor Performance (Learning Style).

Shirley Devard Brown

Louisiana State University and Agricultural & Mechanical College

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THE INTERACTION OF CONCEPTUAL TEMPO AND MODELING ON MOTOR PERFORMANCE

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The Interaction of Conceptual Tempo and Modeling on Motor Performance

A Dissertation
Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Education

The School of Health, Physical Education, Recreation and Dance

by
Shirley DeVard Brown
B.S. Florida A and M University, 1965
M.A. Southern University, 1971
May 1985
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FOREWARD

This dissertation has been prepared in accordance to the style adopted by the American Psychological Association for submission to refereed journals.
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Abstract

This experiment was designed to examine the effects of conceptual tempo and modeling on performance of a serial motor task. There were 48 subjects, 10- and 11-years old males and females, classified as impulsive or reflective. Subjects were randomly assigned to one of three modeling groups or a control group. The modeling strategies included: silent-model, verbal-model and verbal-model with self-instruction. The task was a motor skill obstacle course in which both speed and errors were scored. Data were analyzed by a 2 X 4 (Cognitive Style X Model Type) MANOVA with the number of trials to criterion, the average number of errors per trial, and the average amount of time on the three trials after criterion as the dependent variables. Appropriate follow-up analyses were computed. The results indicated that reflective children performed more accurately (took fewer trials to criterion and made fewer errors per trial) than did impulsive children. There were no differences in the time scores of reflectives and impulsives. More importantly, a cognitive style X model type interaction revealed that student characteristics play a role in the modeling process. More in that impulsive children made significantly more errors than reflective children when performing without a model. Further, the impulsives performed equally as well after observing a silent- or verbal-model, or after observing a verbal-model and participating in self-instruction. The reflective children performed equally as well after observing a silent- or verbal-model and slightly better with a verbal-model plus self-instruction. It was concluded that the modeling process is essential for the impulsive and should be
adjusted in an attempt to make the learning environment compatible with the learning style of the child.
The Interaction of Conceptual Tempo and Modeling on Motor Performance

Cognitive style refers to how a learner processes information and is concerned with the form rather than the content of cognitive activity (Witkin, Moore, Goodenough, & Cox, 1977). Specifically, the construct refers to the manner in which an individual perceives, thinks, solves problems, and relates to others. Conceptual tempo is one way that cognitive style has been classified and identifies an individual as either reflective or impulsive. Impulsive learners respond quickly making many errors while reflective learners respond more slowly making few errors (Kagan, 1965).

An important social process which influences the manner in which individuals acquire new behaviors or change old ones is modeling (Bandura, 1969). The time spent viewing a model can allow the observer an opportunity to plan a course of action and to think about what the consequences of the action might be. Modeling can give the observer important information about the task and how it can be performed in order to get the desired results. Modeling has proven to be effective as a means of acquiring knowledge and skills related to physical activity (Feltz & Landers, 1977; Landers & Landers, 1973). Because of the demonstrated effectiveness of modeling in motor skill performance, researchers have recently started studying factors which may affect the modeling process. For example, at least two studies (Thomas, Pierce, & Ridsdale, 1977; Weiss, 1983) have demonstrated that developmental factors interact with modeling.

Another variable which might play a role in a student's ability to
model motor skills is learning style or, more specifically, conceptual tempo. In describing modeling from a developmental perspective, attentiveness, memory capacity and coding capabilities have been presented as factors influencing the process (Yando, Seitz, & Zigler, 1978). Reflective children have shown more ability to sustain attention (Campbell, 1973; Zelniker, Cochavi, & Yered, 1974) and better auditory and visual memory (Kagan, 1966; Siegel, Kirasic, & Kilburg, 1973) than impulsive children. These characteristics may be relevant to a more thorough understanding of the relationship between movement tasks and observational learning. Hence, the general purpose of this research was to study the interaction of conceptual tempo and modeling in a motor skill instructional setting.

Conceptual Tempo

For many years educators have been aware that individual differences exist in the approach that students take to learning. An understanding of cognitive styles has provided an opportunity for teachers in the cognitive area to adapt curriculum and instruction to the individual student. Cronbach and Snow (1981) present evidence that achievement in cognitive tasks is dependent upon matching of a student's cognitive style and the instructional approach.

Impulsivity-reflection or conceptual tempo has received quite a bit of attention in the research literature in classroom settings. Studies in the cognitive domain have shown that reflective students use more efficient strategies in problem-solving tasks (Ault, 1973; McKinney, 1973; McKinney, & Banerjee, 1975; Siegel, Kirasic, & Kilburg, 1973; ), can selectively attend to relevant cues more efficiently (Weiner &
Berzousky, 1975) than impulsive students, and make fewer errors of omission in serial recall (Kagan, 1966). Kagan, Pearson, and Welch (1966) has shown that, on tasks with response uncertainty, reflectives examined more thoroughly the alternatives before making a response. Further, Katz (1971) found that on a color-form matching task, reflectives gave more mature answers.

Taken together these studies generally show that conceptual tempo influences the manner in which children approach and perform cognitive tasks. Findings have consistently shown that impulsive children tend to be at a disadvantage in intellectual tasks, especially problem solving situations (Readence, Messer, 1976, & Bean, 1978).

The relationship between cognitive style and achievement in motor tasks is not so well defined. Brown, Singer, Canrough and Tucariello (in press) suggest that certain motor skills may be associated with the reflective style while others may require the characteristics of impulsive. These researchers found that reflective adults traversed a maze more slowly and with fewer errors than did the impulsive adults. Further, the performance of reflectives and impulsives was facilitated by an appropriate model.

**Modeling**

While it is readily agreed that modeling improves performance in motor skills, the type of model has recently become an important area of research for physical educators. For example, Gould and Weiss (1981) found that model talk affected the relationship between modeling and motor performance on a muscular endurance task. Weiss (1983) concluded, after studying modeling from a developmental perspective, that verbal
models were more effective than silent-models in directing young children's attention to relevant cues.

Modeling is one approach that researchers in the cognitive domain have taken in attempting to modify the behavior of the impulsive and thus improve chances of success in learning situations (Messer, Readence & Bean, 1978). Using both natural models in a classroom (Yando & Kagan 1968) and experimental models (Debus, 1970; Kagan, Pearson, & Welch, 1966), the response time of the impulsive has been altered successfully by researchers in the cognitive domain. Michenbaum and Goodman (1971) attempted to improve the problem-solving ability of second graders with modeling and self-instruction and were successful in modifying both response time and errors. These studies suggest that the impulsive child and the very young child seem to require modeling plus self-instruction for the most effective learning environment.

While the literature clearly shows that reflectives have a definite advantage in achievement of a cognitive task requiring problem-solving strategies, in motor skills this is still unanswered. Likewise, in motor skills which require problem-solving, an impulsive child may act with little reflection and give little attention to the accuracy of the solution. Further, because impulsives display poorer performance in serial memory tasks, motor tasks which require the learner to recall a specific sequence of movements, may be more difficult for these children.

Gentile (1972) and Fitts (1964) have identified stages of learning which help explain the involvement of cognitive and motor abilities in learning a motor skill. In synthesizing the conceptual suggestions of
Gentile and Fitts, Arnold (1981) described the initial stage of learning as a cognitive or planning stage where the learner decides upon a plan of action and organizes the needed sequence of movement. At this stage, the impulsive child would probably be at a disadvantage, especially in attempting to learn complex skills which are composed of several parts.

The findings from the cognitive style literature could also have important implications for modeling researchers. Because modeling serves as a guide to performance, the observer must be able to symbolically code the modeled behavior which requires visual memory and attentiveness. Verbal self-instruction with modeling may be needed for the impulsive learner, whereas modeling alone may be sufficient for the reflective.

Finally, after a movement sequence is well learned, most errors in accuracy are eliminated and no new problem-solving activity is necessary, the impulsive student may have an advantage in a speed task.

The research findings on sex differences in the conceptual tempo paradigm are not conclusive. Some studies have found girls to be more reflective than boys (Harrison & Nadelman, 1972; Messer, 1976), but the differences were not significant. Sex of the subject has consistently not affected the outcome of conceptual tempo studies. There is, however, evidence that males and females perform differently on a number of motor skills. Several summaries indicate superior performance of males in most movement tasks (Herkowitz, 1978; Keogh, 1973).

The body of research on conceptual tempo can still be considered relatively new and sex might therefore continue to be a variable that is included in these studies. This is especially true when studying the
relationship between conceptual tempo and motor skills. Thus, the specific purpose of this study was to examine the interaction of cognitive style, sex and modeling on children's performance on a serial movement task in which both errors and speed were emphasized.

Upon the basis of the literature reviewed, the following predictive hypotheses were stated: (1) During acquisition, reflective children would perform more accurately (fewer errors) than impulsive children, (2) After the movement sequence is learned, impulsives would perform faster than reflective children, (3) For reflective children a silent or verbal-model, or verbal-model with self-instruction would be equally effective and better than no model during acquisition, (4) For impulsive children a verbal-model with self-instruction would be more effective than a verbal-, silent-, or no-model during acquisition.

Method

Subjects

In this study 93 children were tested ranging in age from 10-11 years who were enrolled at Southern University Laboratory School and First Christian Academy in Baton Rouge, LA. All subjects in this study were black with middle-class backgrounds. Students were tested individually using the Matching Familiar Figures Test (MFFT) (Kagan, 1965) until a sample of 24 reflective (12 males & 12 females) and 24 impulsive (12 males & 12 females) subjects were identified, using error and latency scores based on norms provided by Messer (1976). After reflective and impulsive subjects were identified, the ages ranged from 121 months to 148 months, with a mean age of 133.0 months.
Matching Familiar Figures Test

The test consists of the 14 items contained in Kagan's MFFT (1965) (see Figure 2 for a sample). In this test the child is presented a picture of a familiar object and six alternatives, only one of which is identical to the criterion. Directions provide two practice items and 12 test items, each using an object and six alternatives. The object appears on a page and the alternatives appear on an adjacent page. The child is asked to find the picture on the second page that is exactly like the picture on the first page. If the choice is correct, the child is praised, if incorrect, additional trials are allowed until the correct alternative is located. The two scores are: (1) time to the first response, and (2) the number of errors on each item. Upon completion of the items a separate score is computed for the mean response time to the first choice and the total number of errors. The subjects were classified on a median split of both time and error scores. Impulsive subjects are those who score below the median on time and above the median on errors and reflectives are those who score above the median on time and below the median on errors, using the normative data reported by Messer (1976). In a comprehensive review of different samples (N = 423), Messer provides medians and ranges of response time and errors by age groups. The median number of errors was 7.7 and the median time was 13.6 seconds. Messer reports the reliability estimates to be .92 to .98 for errors and time, respectively.

Testing Equipment

Obstacle Course. The perceptual motor obstacle course by Johnson and Nelson (1979) was revised so as to be more appropriate for 10- and
11-year old children (Figure 1). The course required children to perform specified motor tasks at each of 6 stations in a sequential order.

At the first station, the subject was required to hop right, hop right, jump, jump, hop left, and hop left. At the second station, the subject was directed to jump over, go around, jump over, and go around a rectangle on the floor. Then, at the third station, the subject jumped to geometric patterns using the sequence: square, square, triangle, circle, square. A playground ball had to be (1) dribbled around five cones using first the right hand, (2) tossed three times against the wall and caught, (3) dribbled around five cones with the left hand, and (4) tossed against the wall and caught two times at the fourth station. The subject walked forward, backward, and sideward on a 2 in balance beam at the fifth station. The sixth station required the subject to bounce a ball on the ground inside a hoop with a paddle three times and to stand inside a hoop, and bounce the ball off of the paddle three times against the wall. Finally, the subject ran to a designated spot.

The time to complete the course and any performance or sequence errors were recorded (See Appendix C for complete instructions). Performance errors were such violations as the subject using the wrong locomotor skill, losing control of the ball, or failing to stay on the balance beam. A sequence error was when the subject could not perform the correct pattern or missed a part or all of a pattern. The time score was the time in seconds that it took each subject to complete the obstacle course.
Procedures

Subjects were first administered the MFFT to identify their cognitive style. The experimenter continued to test until 24 reflective and 24 impulsive subjects were classified for this study. The mean time for the reflective boys was 21.44 sec (SD = .84) and the mean number of errors was 2.7 (SD = 1.92). The impulsive boys had a mean response latency was 7.46 (SD = .27) with 8.8 as the average number of errors (SD = 2.08). The results for the reflective girls on response latency was 18.47 (SD = 5.51) and the mean number of errors was 2.5 (SD = 1.62). The impulsive girls mean time was 7.99 (SD = 2.78).

The subjects were told that the experimenter wanted to see how quickly they could complete the obstacle course while making as few errors as possible. All treatment groups were given instructions by the experimenter for completing the obstacle course twice (Appendices B & C).

Subjects were randomly assigned within gender and cognitive style to one of three modeling groups or a no-model group. The random assignment was completed with one constraint: to ensure that each model and cognitive style group was represented by the two age groups, equal numbers of males and females was sometimes not possible. For each model group and the control group there were 6 impulsive and 6 reflective subjects. In most cases the 6 subjects within a cognitive style and group included equal numbers of males and females. When equal representation did not include at least one subject from each age group, an adjustment was made (Appendix D). The models used were either a silent-model, a verbal-model, or a verbal-model with self-guidance. The
silent-model demonstrated the movement sequence involved in the obstacle course, moving at a medium speed but making no errors. The verbal-model demonstrated the movements at a medium speed and verbalized aloud the sequence. In addition to the sequence, the verbal-model made statements about performance such as: I am going to keep the ball low so I will not lose control; and I am holding my arms out for balance on the beam. The verbal-model plus self-instruction demonstrated the movements, verbalized aloud the sequence, made statements about technique and trained the subjects to recite the sequence and make the statements about technique. Children in the no-model group were given verbal instructions only.

The researcher served as the model and the tester. Each subject was tested individually beginning with the no-model group. The three remaining groups were tested in random order. The no-model group was tested first to try to diminish as much sharing of information as possible from the other three treatment groups. Further, the no-model group was required to wait the average amount of time needed to observe a model before beginning the run. This was done to eliminate any differences in the cognitive style groups to use a rehearsal strategy. Upon arrival at the test station, the subjects were told that the experimenter wanted to see how quickly they could go through the obstacle course making no errors. All treatment groups were given verbal instructions two times for completing the course. The subjects in the no-model group were then asked to complete the course. Subjects in the silent- and verbal-model groups observed the appropriate model and then completed the course. After observing the model, subjects in
the verbal-model self-guidance group practiced the sequence until it could be verbalized without error. These children were also required to include some hints for successful performance.

A maximum of 15 trials was given for each child to reach a criterion of three or less errors. The maximum number of trials as well as the length and difficulty of the sequence was determined by pilot testing (Appendix E). It was confirmed that children 10- and 11-years old would maintain interest for approximately 15 trials and could learn the selected sequence. For each of the acquisition trials, time and error scores were recorded. Time was recorded as the number of seconds required to complete the course. The error score included both sequence and performance errors. If a subject forgot the sequence, the child was encouraged to continue to the next station and a maximum number of errors for the station was recorded (See Appendix C).

The subject continued until the criterion of three errors or less was reached. After criterion, each subject was given three additional trials. For these trials, the children were told: "Now I want you to see if you can complete the course in a faster time but still without errors. You know the sequence, now think about speed." Again time and error scores were recorded.

On the following day, subjects were tested on five additional trials to determine how well they had learned the course. For each subject, the directions were given by the experimenter twice for completing the course. They were then told to go as fast as they could and make as few errors as possible. Time and error scores were recorded.
Analysis

The results were analyzed in a 2 X 2 X 4 (Learning Style X Sex X Model Type) ANOVA to compare group differences on the following performance measures: (1) number of trials to criterion (2) average number of errors per trial and (3) average time on the three trials after criterion. In addition, Pearson product moment correlations were computed for the number of errors per trial and the time per trial for each subject on the first two trials. This computation was done to determine if the negative relationship which has been found consistently between MFFT response time and errors was apparent on the obstacle course. In a review of 20 conceptual tempo studies, Messer (1976) reported correlations ranging from -.01 to -.75 for response time and errors as measured by the MFFT.

A 2 X 2 X 4 X 5 (Learning Style X Sex X Model Type X Trials) MANOVA with repeated measures on trials was used to determine if there were trial differences on the speed scores for Day 2. Trial 1 had a slightly but significantly higher time score. Because this was the only significant difference, the scores for the 5 trials on Day 2 were averaged. Then a 2 X 2 X 4 X 2 (Learning Style X Sex X Model Type X Trials) ANOVA was computed with the average of the last three trials from Day 1 as trial 1 and the average from Day 2 as trial 2.

Results

The 2 X 2 X 4 (Cognitive style X sex X model type) MANOVA performed on the data to compare group differences on the number of trials to criteria, the errors per trial, and the average amount of time on the three trials after criteria revealed a significant main effect for
cognitive style, $F(3,30) = 4.13, p < .01$ and model type, $F(9,73) = 3.99, p < .01$. There was also a significant cognitive style X model type interaction $F(9,73) = 2.37, p < .05$. Because there were no sex differences, the decision was made to complete all subsequent analyses collapsed across sex. Considering the small sample size, this decision increased the power of the test and was thus considered appropriate.

The follow-up ANOVA (2 X 2 X 4) with the number of trials as the dependent variable yielded significant differences for cognitive style, $F(1,40) = 9.17, p < .01$, model type, $F(3,40) = 13.06, p < .01$, cognitive style X model type, $F(3,40) = 3.37, p < .05$. Impulsive children had significantly more trials to criterion than did reflective children. The means and standard deviations are shown in Table 1. Results of Newman Keuls follow-up analysis indicated that subjects who did not receive a model took significantly more trials to reach criterion than did subjects with a silent-model, a verbal-model or a verbal-model and self-instruction. The latter three model groups were not significantly different (Table 1).

The cognitive style X model type interaction is shown graphically in Figure 3. Planned comparisons indicated that the impulsive subjects in the no-model treatment had significantly more trials to criterion ($M = 11.2; SD = 3.4$) than the reflective subjects ($M = 6.8; SD = 3.1$) in the no-model group. All modeling strategies helped the impulsive subjects to reach criterion with fewer trials than with
no-model. Inspection of Figure 3 shows that with one minor exception, the participants receiving any of the modeling treatments, regardless of cognitive style, displayed essentially the same behavior. While the reflective subjects learned the task to criterion with slightly fewer trials with a verbal-model and self-instruction, post hoc Newman Keuls analysis indicated this was not a significant difference.

The ANOVA with the number of errors per trial as the dependent variable yielded significant differences for cognitive style, $F(1,40) = 9.76, p < .01$. The impulsives had significantly more errors per trial ($M = 12.0; SD = 3.7$) than the reflectives ($M = 8.6; SD = 4.17$) (See Table 1). There were no significant differences for the main effects of model group or sex, nor for any of the interactions.

The same univariate procedure used on the number of trials to criterion and the number of errors per trial was used to examine differences in the time scores after criterion had been reached. Neither the main effects nor any of the interactions approached significance.

Results of the Pearson-product-moment correlations for errors and time on trials one and two yielded moderate to high coefficients (see Table 2). As shown, the coefficients for errors on Trial 1 with errors on Trial 2 were high and significant for both impulsive and reflective students ($rs = .81$ and $.71$, respectively). Likewise, the relationship between time scores on trials one and two for both types of students
were moderate and significant ($r = .61$ and $.60$). These relationships were expected. In addition, the correlation coefficients for impulsive time and error scores on trials one and two were positive, with $rs$ ranging from $.13$ to $.40$. As shown in Table 2, the relationships between time and error scores for reflectives were considerably higher than for impulsives. These coefficients ranged from $.34$ to $.68$, with only one ($34$) failing to be significant.

A $2 \times 4 \times 5$ (Cognitive Style X model group X trials on day 2) ANOVA with repeated measures on the last factor was computed to determine if there were differences in time scores over trials. The dependent measure was time on the five trials. Results indicated significant effects for trials, $F(4,200) = 1.85, p < .01$. The mean for Trial one ($M = 105.89, SD = 25.42$) was significantly higher than the means for Trials two ($M = 97.81, SD = 23.81$), three ($M = 94.49 SD = 20.37$), four ($M = 93.55, SD = 21.22$) and five ($M = 91.62, SD = 21.56$). The latter four trials were not significantly different from each other, nor were there any other significant effects.

To determine the differences in time for Day one and Day two, a $2 \times 4 \times 2$ (Cognitive Style X Model Group X Trials) MANOVA with repeated measures on the last factor was computed. The dependent measure was the average time for the three trials after criterion was reached on Day one and the average of the five trials on Day two. Results indicated that there were no significant differences for the main effects or interactions.

Discussion

The findings in this study support a major hypothesis related to
the motor skill performance accuracy of children classified as impulsive or reflective. Reflective children performed with fewer errors and used fewer trials to criterion than did the impulsive children. These results support previous research in the cognitive domain which has shown that reflectives can selectively attend to relevant cues more efficiently than impulsive students (Weiner & Berzousky, 1975), make fewer errors of omission in serial recall, (Kagan, 1966), and examine more thoroughly the alternatives before making a choice (Wright, 1971). The tendency of reflective children to consider more thoroughly the possible alternatives extends to performance in motor tasks which involve memory of a sequence. The reflective subjects appeared to cognitively encode the elements of the task more readily than the impulsive, thereby reducing the number of trials required to reach criterion and the mean number of errors per trial.

A second major hypothesis in this study, that after students reached criterion for accuracy, impulsives would perform faster than reflectives, was not supported. Children, regardless of conceptual tempo, had similar time scores for the obstacle course. Even when time scores were analyzed for the 5 trials given a day after the initial learning trials, there were no differences in the cognitive style groups. Perhaps the impulsive students, even after reaching criterion, had to pay more attention to components of the task. Another explanation might be that the time scores included both response latency and speed to complete the obstacle course. Previous research has indicated that impulsive subjects tend to react to cognitive tasks quickly without evaluating alternatives (Kagan, 1965). In this study
the latency time was standardized for the control group so that the modeling effect would not be confounded with the tendency to use appropriate rehearsal strategies. Thus response latency would be available for the treatment groups only. A parallel tendency of impulsive subjects to react quickly in motor skills could have been more appropriately determined if two time scores had been recorded: One, from the time the instructions about movement sequence were given until the first step was taken, and two from beginning until completion of the movement sequence. The lack of separate latency and movement speed scores may be a limitation of the present study and thus some caution should be taken when interpreting the results. Future research should be designed to determine if impulsive and reflective students differ in response latency for a motor task.

A third major hypothesis was related to the interaction cognitive style and modeling. It was predicted that reflective children would perform equally well with a silent-model, a verbal-model, or a verbal-model with self-instruction, while impulsive children would perform best under the verbal-model, self-instruction condition. Findings partially substantiated these predictions. The significant cognitive style X model type interaction generally supported the notion that cognitive style plays a role in the modeling process but not exactly to the extent predicted. For example, reflective children performed approximately the same under the no-model and model conditions. On the other hand, impulsive children performed approximately the same under the three modeling conditions and significantly better than with no-model.

Again, some caution should be taken, when interpreting these
results. While the reflective children showed significantly better performance without a model than the impulsive children, other factors may be equally responsible for these results. For example, the initial motor skill level of the students identified as impulsive and reflective was not determined. Although having all children reach an established criteria was an attempt to equalize any initial skill differences, no actual assessment of motor skill was taken. Another limitation of the present study may be related to experimenter bias. Instructions were given and performance was measured by the experimenter who was also the researcher. Given the objective nature of the task, it was assumed that this procedure was no threat to internal validity.

It appears that a model is extremely important and effective in assisting the impulsive learner with acquiring accuracy in a serial motor task. This is apparent since the no-model groups, both reflective and impulsive, were required to wait an average amount of time needed to observe a model and the model with self-instruction. The silent- and verbal-model groups were also given additional time to think about the sequence of the course. Thus, this eliminated some of the possibility that mental rehearsal was an important factor. These findings have implications for school learning. While providing a demonstration to facilitate performance in motor skills has been accepted as a valuable process in physical education for years, this technique appears to be extremely necessary for the impulsive learner. In individualized learning environments the reflective student might successfully obtain information concerning what is required from a written task sheet. The impulsive learner, in contrast, needs something more than a verbal
explanation. Following the same line of thinking reflectives may be more adept at discerning information from a written task sheet.

Previous studies have purportedly determined the existence of low to moderate negative relationships between MFFT response time and errors. Present results indicated positive relationships between errors and time for both impulsive and reflective subjects. When considering the way time was measured in this study, this finding is not surprising. Response time in previous studies represents the period of time after the problem is presented until the first response. Thus, time to complete the assignment or select the correct answer is not recorded. Response time in this study included the time needed to complete the task. Further, the correlations were computed on the first two trials, when children were making more errors. The children who made more errors had to think about the correct sequence, thus delaying completion of the task. This was true for both reflectives and impulsives. Again it becomes apparent that the response latency scores and movement time scores should be separated in future studies.

This study was one of the first attempts to relate cognitive style to an instructional process in physical education. In summary, the findings suggest that the performance of a student with an impulsive conceptual tempo is different from that of a reflective on a sequential motor task. The impulsives subject's performance can be altered by a modeling strategy and thus facilitate performance.
References


Table 1.

Means for Cognitive Style and Treatment Groups

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<th>Time</th>
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<td>M</td>
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</tr>
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</tr>
<tr>
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<td>2.3</td>
<td>9.5</td>
</tr>
<tr>
<td>Verbal-model with self</td>
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<td>1.6</td>
<td>9.0</td>
</tr>
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Table 2.

Correlation Coefficients for First Two Trials for Impulsive and Reflective Subjects

<table>
<thead>
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<th>Errors 1</th>
<th>Time 2</th>
<th>Errors 2</th>
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<tr>
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<td>.61*</td>
<td>.21</td>
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<tr>
<td>Errors 1</td>
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<td></td>
<td>.13</td>
<td>.81**</td>
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<tr>
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<tr>
<td>Errors 2</td>
<td>.34</td>
<td>.71**</td>
<td>.68*</td>
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</tr>
</tbody>
</table>

Note - rs above the diagonal are for impulsives, below the diagonal for reflectives.

* p < .05

** p < .01
Figure Captions

Figure 1. Obstacle Course.

Figure 2. Sample of Kagan's MFFT.

Figure 3. Trials to Criterion for Cognitive Style X Model Type Interaction.
Figure 1.

Station 1

Station 2

Station 3

Station 4

Station 5

Station 6

Start

Finish
Figure 2.
Figure 3.

Trials to Criterion

- Impulsive
- Reflective

No-model silent-model verbal-model verbal-model self-instruction

Model Type
APPENDICES
Appendix A

Extended Literature Review

Cognitive Style and Modeling: A Possible Aptitude Treatment

Interaction Question
APPENDIX A

Cognitive Style and Modeling: A Possible Aptitude Treatment

Interaction Question

For years educators have been aware that individual differences exist in the approach that students will take to learning situations. As a result of the many attempts to understand these differences, there has emerged a body of research that is called cognitive style or learning style. Cognitive style refers to a preferred mode of responding in learning situations. An understanding of cognitive styles has provided an opportunity for teachers to adapt curriculum and instructional approach to the individual student. Cronbach and Snow (1981) present evidence that achievement in cognitive tasks is dependent upon the matching of a student's cognitive style and instructional approach. An individual reaction to a particular stimulus depends on how one perceives and understands the situation.

People learn in different ways and make use of different cognitive processes as they go through the learning process. Teachers must be aware of the different styles or better yet, identify the style preferred by each learner. When the student fails to learn, it is not a single factor related to the teacher, the environment, or the learner. But, rather consideration should be given to all possible combinations of these contributing factors.

After years of research in individualization, there are researchers such as Witkin and Goodenough (1981) who have indicated that the aim of cognitive style should not be to enlarge the present body of knowledge already on record concerning individual differences. Instead,
individual differences in perception need to be used as points of departure for studying the modes of personal functioning of cognition.

It seems timely to bring to the attention of educators the concept of cognitive styles and their relationship to the learning process. Cognitive styles are described as being pervasive (Kagan, 1965; Rudin & Stagner, 1958; Witkin & Goodenough, 1981). The characteristic of pervasiveness has important implications for the educational setting. In view of this factor, cognitive styles carry a message about the personality of the individual. It can be considered, because of personality and not just cognition, that an individual likes to be with people, and is attentive to what others say and do. Also, some types of individuals take into account the information from others in defining their own beliefs and feelings (Witkin et al., 1977). The pervasiveness of cognitive styles also means that they can be assessed by objective nonverbal methods. To the extent that perception can be assessed by objective, controlled techniques, perceptual performance may be used as a measurable indicator for identifying an individual's cognitive style.

Another characteristic of cognitive style is that it is stable over time (Eska, 1971). This does not mean to imply that a style is unchangeable. In the normal course of events, however, we can predict with some degree of accuracy that a person who has a particular style one day will have the same style the next day, month, and perhaps a year later. This notion was proven in two experiments published by Kagan (1964). In the first study, 104 boys and girls were individually administered the Matching Familiar Figures Test (MFFT) which was developed by Kagan and associates to measure conceptual tempo. The
testing initially occurred when the subjects were in grades 3 and 4. One year later 11 subject were given a slightly different version of the MFFT. The correlation between response time on the first and second administration for both boys and girls in both grades was .62.

Kagan's second experiment involved a group of 102 children who were given the MFFT in the spring of their 1st year and again 1 year later. The correlations for response time between the two administrations were .48 for boys and .52 for girls. The tendency to display fast or slow decision time proved relatively stable when restricted to the same test.

In describing cognitive styles, another characteristic is that they are bipolar. This characteristic is of particular importance in distinguishing cognitive style from intelligence and other ability dimensions (Witkin et al., 1977). Each pole has adaptive value under specified circumstances, and may be judged positively in relation to those circumstances.

Just as there are many individual differences among students, there are many variations in defining or describing cognitive styles. Most of the research in education has included field-dependence independence and impulsivity-reflection. If learning style differences can be accepted as a viable aspect of learning, then the differences in cognitive styles mean that certain educational approaches are more effective with some learners than with others. The Modeling process may be one example. Further, in some cases the student may show more success if the cognitive style of a student is modified. Thus the following is a review of literature pertaining to the behavior of students with different cognitive styles as to how these may interact with modeling,
and the use of modeling as a process which might assist students in becoming more successful. Specifically, the cognitive styles considered will be field-dependence/independence and impulsivity-reflection. From the evidence available, these two constructs seem to be describing similar learner characteristics and could thus be taught using the same educational approaches.

**Field-Dependence/Independence**

A large portion of the research to date on cognitive styles has been done in the area of field-dependence/independence. Witkin and Goodenough (1977) extended some of Witkin's earlier work (1965) to psychological differentiation, the segregation of self from nonself. The basic idea here is that boundaries are established between the inner and outer self. Certain attributes are identified as one's own and distinct from those of others. Differences in the degree of self-nonself segregation lead to differences in the extent to which the self is likely to be used as a referent for behavior. The tendencies to rely on self or field as a primary referent are the field-independent and field-dependent cognitive styles, respectively.

The main perceptual tests used to assess the extent of field-dependence reflect the degree of reliance on internal or external referents. This becomes evident when one considers the way that subjects perform on the tests. Classification of subjects is usually the results of scores obtained on an Embedded Figures Test (Witkin et al., 1977) or the Rod and Frame Test (Witkin, 1949). Subjects who have the ability to find a figure or vertical position as classified with these tasks are identified as field-independent. Witkin, Dyk, and
Taterson (1962) described the field-independent individual as one who perceives items as distinct from the backgrounds and field-dependent as viewing them within their particular embedded context.

Wareing (1981), attempted to determine if there was a relationship between field-dependent or field-independent cognitive styles and attitudes toward science. It was hypothesized that field-independent or analytical students would develop significantly more positive scientific attitudes than the field-dependent or global learners. The research did show a relationship between cognitive style and a scientific attitude.

Some implications for the elementary teacher stated by Wareing are:

1. Close scrutiny of affective dimensions and consideration or student cognitive style should further enlighten science teachers regarding choice of programs and learning modalities.
2. Teachers should state definitively their expected outcomes with designated curriculum programs.
3. Elementary science teachers need to examine personal sentiments toward methods of teaching students with different cognitive and affective perspectives.

When various learning styles of students are identified, more achievement can be expected if these students are matched with teachers who exhibit similar teaching styles. The field-independent characteristics of both teacher and student was tested by Saracho and Dayton (1980) to determine if in fact there was a relationship between the two groups. A significant finding was the effect of the teachers' cognitive style and the academic achievement of their students.

Students of field-independent teacher obtained higher scores on the
posttest than the students of the field-dependent teachers. This would seem to indicate that the results were more affected by the teacher's cognitive style than by appropriately matching students and teachers with the same cognitive style. Particularly impressive is the evidence of differences in characteristics falling in the social domain. Taken collectively, the social characteristics that distinguish persons that are field-independent are that they are less likely to make use of prevailing social frames of reference or establish values on them (Witkin et al., 1977). On the side of attentiveness to social cues, impressive evidence from many studies, using a variety of approaches and procedures, indicates that field-dependent persons have what in effect amounts to a sensitive radar system. It has been demonstrated that relatively field-dependent persons literally look more at the faces of others than field-independent persons and use this information as a source of information about what others are feeling and thinking (Konstadt & Forman, 1965; Nevill, 1972; Ruble & Nakamura, 1972). The selective interest of relatively field-dependent persons in social aspects of the surroundings is not limited to faces. There is evidence which suggest that these individuals attend more to verbal messages with social content, even when the message occurs just outside of their immediately environment (Fitzgibbons, Goldberg, & Eagle, 1965).

There are additional social factors which have been observed and yielded significant differences for field-dependent/independent subjects. Field independent persons are more authoritarian (Rudin & Stagner, 1958) and generally unwilling or unable to contribute effectively to conflict resolution by accommodating their point of
to that of another. (Oltman, Goodenough, Witkin, & Freedman 1975). In a similar study, Solar, Davenport, and Bruehl (1969) found that field-dependents were social compliant whereas field-independents showed an active and manipulative orientation to the social environment.

When restructuring a stimulus pattern is required for success in a task, field independent persons usually show higher achievement. McLeod and Adams (1979) found that field-independent students showed greater achievement in mathematics with maximum opportunity for discovery, while field-dependent students achieved more in an expository environment. Extensive evidence is available which indicates that in general field independent students are more advanced in reading, mathematics English and geography (Readence, Baldwin, Bean, & Dishnor, 1980; Satterly, 1976; Satterly, 1979; Vaidya, 1980; Wineman, 1971). The data available in the literature are mixed as to the relationship between sex and cognitive styles. Allen (1978) conducted a meta analysis of the literature which did not find a significant difference between the sexes. It appeared that gender accounted for less than 15% of the variance in field-dependent scores. In a study by Pitblado (1976), 15 women and 24 men were compared on a visual orientation task. The subjects were required to observe and set a luminous line to a vertical position while viewing from a laterally tilted body position. As a group, women were not significantly different from the men in that neither group was not significantly different from zero in either direction of body tilt. In this study, the direction of the difference found clearly limits the generalizing of the field-depedent concept as a predictor of sex differences in spatial performance. On the other hand, there is some
evidence of differences between the sexes. Several researchers found females more field dependent than males (Lotwick, Simon, & Ward, 1982; Perney, 1976; Witkin, 1977). Witkin (1977) has noted, however, that the differences between the sexes are quite small when compared to the differences within the sexes.

Developmentally, there is an increase in field-independency from about age 5 to 15 (Witkin et al., 1977). The level that is reached is maintained to about the early 40s. During these growing years, there is a relatively stable state of field-dependence/independence. Children tend to maintain the same position relative to their age group as they grow up. As a group, children show movement toward greater field-independency.

During young adulthood, there is almost absolute stability even over extended periods of time (Faterson & Witkin, 1970). Bauman (1951) reported very high correlations between test-retest during a period of more than three years. In working with young adults, he found evidence of change during major changes in life experiences such as marriage, psycho-therapy or divorce. Results of one study (Cionini, Margaro, Smith, & Velegnola 1979) indicated that for the sample of male and female Italians, there was a significant negative relationship between age and field-independence. This study examined the relationship between age and field-dependence while controlling for educational background and socioeconomical status of the families. Control of the educational variable did not alter the magnitude of this relationship in the male sample, but reduced it in the female sample. Females showed a
reduction in the relationship between field-independence and age.

Research relating the learning and performance of motor skills to different levels of field dependence/independence is limited. Two studies by Pargman and associates (Pargman & Ward, 1976; Pargman & Inomato, 1976) suggest that performance of motor tasks containing a disembedding aspect relates to a person's perceptual cognitive style. Other researchers have found field independence to be related to higher performance in fencing (Williams, 1975); individual sports (Bard, 1972); and dance (Garnes, 1975).

Impulsivity-Reflection

Impulsivity-reflection or conceptual tempo is another dimension of cognitive style which has received quite a bit of attention in research. This is a decision time variable that refers to the degree to which an individual reflects over his hypotheses in a problem-solving situation of high response uncertainty (Kagan, 1965). Children who are reflective tend to make few errors on word recognition and paragraph reading tasks. The Matching Familiar Figures Test (MFFT) (Kagan, 1965) was developed to discriminate between children who respond quickly, with many errors, and those who take longer to respond resulting in few errors. The task requires the subject to compare a standard figure to six alternatives and to select the one that is identical to the standard. Elapsed time and errors are the two components on which the test is scored (Kagan, 1965). Subjects who respond slowly, with few errors are labeled reflective, while those who respond quickly with many errors are considered impulsive. Groups are divided by a median split on the error scores and the elapsed time.
Data obtained from many groups of children in grades 1 through 4 indicate that response latencies increase and recognition errors decrease with age (Kagan, 1965). Moreover, at every age there are consistently high negative correlations between response latency and frequency of recognition errors in discrimination tasks that use either geometric designs or familiar objects. The impulsive child who makes fast decisions usually makes more errors than the reflective child who has a longer decision time.

Studies in the cognitive domain have defined differences between reflective and impulsive children. Reflective students use more efficient strategies in problem-solving tasks (Ault, 1973; McKinney, 1973) and can selectively attend to relevant cues more efficiently (Weiner & Berzousky, 1975) than impulsive students.

Impulsive subjects make quick selections on the MFFT to one of the alternatives available. In some cases they probably do not examine all of the alternatives, but rather select the first one that seems to be the same as the standard. This was empirically proven by Siegleman (1969), who found that impulsives ignored two and one-half times as many alternatives per item as the reflective subjects. Further, it was found that the reflective was viewed by others with greater consideration and more systematically. The reflective not only spends more time evaluating hypotheses, but also gathers more information on which to base a decision, and thus makes fewer errors than the impulsive subject.

Several investigators have related reflection-impulsivity to field dependence/independence and there appears to be some similar
characteristics between the two styles. Reflectives have been more field independent than impulsives in most studies (Campbell & Douglas, 1972; Schleifer & Douglas, 1973; Massari, 1975; Neimark, 1975). Messer (1976) suggests that the association between the two types of processing styles is due to the similarity of the tests usually used to measure the characteristics. Both the MFFT and the Embedded Figures Test contain uncertainty and require analysis of a visual field. Neimark (1975) found that both reflectives and field independent children were more efficient in problem solving activities.

Taken together these studies indicate that student characteristics related to the cognitive style dimension range from global to analytical and from a social being who tends to make errors to an autonomous being who makes few errors. Students with analytical tendencies probably have the ability to succeed in an instructed environment where self direction and evaluation are allowed. On the other hand, students with a more global style need externally defined goals and direct reinforcement. There is some evidence that these students learn more efficiently when a variety of instructional materials are available. For example, Koran, Snow and McDonald (1971) found differences in the quality of field-dependent and independent adults to acquire a teaching skill from written and video-modeling procedures. While field-dependent subjects learned more from written and video modeling, field-independent subjects did as well with written instructions as they did with both written and video procedures.

Attempts have been made to maximize the performance of all learners. Inasmuch as reflectives usually perform better than
impulsives on most tasks, it might be well to try to have the latter replicate the response style of the former cognitive style. Kagan, Pearson, and Welch (1966) attempted to experimentally manipulate the response time variable. Delay training for impulsive subjects was found to produce significantly longer MFFT response time, but errors did not decrease correspondingly. This observation suggests that simple delay training is insufficient to make an impulsive child behave like a reflective child. Perhaps an additional type of training should occur during the time between responses in order to reduce the number of errors. Genshaft and Hirt (1979) trained impulsive subjects through modeling and self-instruction. Black and white ghetto children were trained by either a black model or a white model. Subjects trained by the white model improved significantly on the MFFT response time as compared to those trained by the black model or no model. Both model groups, however, were found to enhance their performance over the no model group condition when trained by models of their own race. Despite the fact that low socioeconomic black children have been often described as lacking in verbal ability, modeling and self-instruction seems to be at least one viable avenue to improve that condition.

Summary

While the construct of conceptual tempo has not been researched in relation to motor skill acquisition, one might expect results similar to those from the field-dependent/independent literature. If restructuring the visual field or problem solving is involved, the reflective would be more successful. If speed is important to success the impulsive may have an advantage. These questions must be answered in future research.
In any case, modeling should be considered as a process for insuring more success of individual students. Modeling has been used to improve existing motor skills regardless of the learner's cognitive styles (Landers, 1975; Thomas, Price, & Ridsdale, 1977; Weiss, 1983).

Some students may need a model to supplement verbal instruction to a greater extent than others. The impulsive or the field-dependent individual should learn more efficiently when videotapes, films, or other stimuli are provided. Future research must address the possible interaction between cognitive style and the modeling process. Only then can physical educators match the learning environment to the individual student. Finally, because modeling has been successful in modifying the cognitive style of learners it could be extremely useful in compensating for a student's weakness in performance of motor skills. It is the responsibility of all teachers to capitalize on the student's strengths and circumvent any weakness.
Additional References


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Psychological Issue Monograph 51. International Universities Press, 

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APPENDIX B

Treatment Groups
No-model. Subjects were given verbal instructions for completing the obstacle course twice. Upon completion of the instructions by the experimenter, the subject began to complete the course. After two attempts, the instructions were given again, this continued until criterion was reached.

Silent-model. After verbal instructions, the experimenter completed the course while the subject watched. The pace was completed at a moderate pace to allow the subject an opportunity to carefully observe. The condition was repeated after two attempts until criterion was met.

Verbal-model. Upon completion of the verbal instructions, the experimenter began to go through the obstacle course. The sequence was verbalized as well as helpful hints to perform each component of the course. The model condition was repeated for the subject after two trials by the subject.

Verbal-model with self-instruction. This condition combined the elements of the three previous conditions plus training of the subjects to correctly repeat the sequence before beginning.
APPENDIX C

Directions for Completing the Course
Directions for Completing the Course

When the subject reported the testing site, the experimenter said, "This is an obstacle course and I would like to see how fast you can go through it and make as few mistakes as possible. At this station (1) you are to hop on your right foot and hop on your right foot, on the patterns on the right side. Then, using both feet jump, jump on both feet and hop on the left foot, hop on the left foot on the patterns on the left side. Here (station 2), you are to jump over the first rectangle, go around the next, hop over the next, and go around the last one. Now, you will jump from figure to figure. Jump on a square, a square, a triangle, a circle and a square (station 3). Go and get the ball out of the hoop (station 4) and with your right hand, dribble the ball around the cones, without touching it with you left hand. Toss the ball against this wall three times and catch it without letting it hit the floor. Dribble back around the cones, using the left hand without touching it with your right hand. Toss the ball on this wall and catch it two times without letting it hit the floor. Place the ball back inside of the hoop and go to the balance beam. On the balance beam (station 5), walk forward, walk backward, and then sideward trying not to step off. Run and pick up the paddle (station 6) and ball, then bounce the ball down inside of the first hoop three times while standing outside of the hoop. Stand inside of the second hoop and bounce the ball up on the paddle three times. Hit the ball against the wall three times, letting it bounce once on the floor as though playing tennis. Then, place the paddle and the ball inside the hoop and run to here (a designated spot)." The time started when the experimenter said "go" at
the start line and was stopped when the subject reached the designated spot.

If a subject completely forgot a sequence at a station, encouragement was given to continue, and the following number of errors were assigned for each station:

   Station 2 - 4
   Station 3 - 5
   Station 4 - 10
   Station 5 - 15
   Station 6 - 5
APPENDIX D

Number of Subjects Per Group

55
Table 3.

**Number of Subjects Per Group For Cognitive Style**

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<tr>
<th></th>
<th>Impulsive</th>
<th></th>
<th>Reflective</th>
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<tr>
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<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
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</tr>
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<td>2</td>
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<tr>
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<td>12</td>
<td></td>
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<td>Verbal-Model/self-guidance</td>
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</table>

Total                          12  12  12  12  48
APPENDIX E

Pilot Study To Establish Criterion
Pilot Study

Purpose: The purposes of this pilot study were (1) to determine how subjects would progress over trials on an obstacle course in which both speed and errors were stressed and (2) to determine if a model would improve the scores for time and errors.

Subjects: Subjects were three 11 year old children.

Procedure: Two subjects were given verbal instructions and were then asked to complete the obstacle course as fast as possible, making as few errors as possible. One subject was given verbal instructions and then provided a verbal-model.

Results: Results indicated that over trails both time and errors scores could gradually be improved. Further, a verbal-model enhanced performance. Scores for the three subjects are shown below.

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<td>3*</td>
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<td>94.3</td>
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*Received a verbal model
Appendix F

Summary of Analysis of Variance
Table 4.
Summary of Analysis of Variance for the Number of Trials to Criterion

<table>
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<th>Type III SS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>1</td>
<td>40.33</td>
<td>9.17*</td>
</tr>
<tr>
<td>Trt</td>
<td>3</td>
<td>172.42</td>
<td>13.06***</td>
</tr>
<tr>
<td>Group X Trt</td>
<td>3</td>
<td>44.50</td>
<td>3.37</td>
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<tr>
<td>Error</td>
<td>40</td>
<td>121.33</td>
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</tr>
</tbody>
</table>

Table 5.
Summary of Analysis of Variance for Average Number of Errors per Trial to Criterion

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<td>138.04</td>
<td>9.76*</td>
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* p < .05
Table 6.
Summary of Analysis of Variance for Time on Five Retention Trials.

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<tbody>
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<td>3313.78</td>
<td>7.18*</td>
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<tr>
<td>TRT</td>
<td>3</td>
<td>4097.39</td>
<td>2.96*</td>
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<td>17677.08</td>
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<tr>
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<td>92351.59</td>
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Table 7.
Summary of Analysis of Variance on Time Scores For Day One and Day Two

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<tbody>
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<td>Group</td>
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<tr>
<td>Error</td>
<td>40</td>
<td>2323.43</td>
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</tbody>
</table>
VITA

Shirley Delores DeVard Brown was born in Tampa, Florida, May 27, 1944 to John Clark and Ethel Mickles DeVard. She was one of four children. She attended public elementary school in Tampa before going on to complete Middleton Senior High School in 1961. For three and one-half years she matriculated at Florida A and M University and graduated with honors in June of 1965, with a Bachelor of Science degree in Physical Education and a minor in Driver's Education. From that time, she has been employed in the field of education, on the elementary to college level. The Master of Arts degree was received in 1971 from Southern University in Education with an emphasis in Physical Education. In the fall of 1983, she was granted a sabbatical leave from Southern University to pursue full-time a doctoral study in Physical Education with a specialization in Professional Preparation and a minor in Curriculum and Instruction. The Doctor of Education Degree was awarded in May, 1985.
Candidate: Shirley DeVard Brown

Major Field: HPERD (Professional Preparation)

Title of Dissertation: The Interaction of Conceptual Tempo and Modeling on Motor Performance

Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

April 24, 1985