

The Effect of Frequency of Perceptual Modeling on the  
Acquisition of a Coincident-Timing Task

An Honors Thesis (HONRS 499)

by

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Ball State University

Muncie, Indiana

June 18, 1992

December 20, 1992

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### Abstract

The purpose of this thesis was to explore whether increased frequency of exposure to the perceptual demands of a coincident-timing task (perceptual modeling) prior to actively practicing the motor component of the task would result in increased timing accuracy on initiation of practice. Increased accuracy following a high frequency of modeling would presumably be due to an enhanced cognitive representation for the skill.

Forty-four subjects were randomly assigned to one of four different groups: a control group receiving no perceptual modeling, a group receiving one chance to experience the perceptual demands of the task prior to active practice (perceptual modeling), a group receiving five chances, or a group receiving ten chances.

Results indicated that perceptual modeling at any frequency enhanced the accuracy of the cognitive representation and decreased timing errors, as each perceptual modeling group differed significantly from the control group. However, none of the groups receiving modeling differed significantly from any other. Thus, increased frequency of exposure was not superior to limited exposure for this particular task.

The Effect of Frequency of Perceptual Modeling on the  
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Instructors and teachers in sport and physical education have long accepted demonstration, commonly referred to as modeling, as a viable method of skill instruction. Some common examples for the use of modeling in athletic and physical education settings would be providing pre-practice demonstrations of such skills as batting a ball, shooting a lay-up, or a golf swing.

Bandura's "mediational-contiguity theory" has been the major theoretical basis for observational learning in the last twenty years (Bandura, 1969; McCullagh, Weiss, & Ross, 1989). Although social psychologists have readily accepted Bandura's theory and have concluded that modeling through demonstrations or imitation can teach attitudes, values and skills necessary for socialization, limited research has been conducted on the ability of modeling to accelerate motor skill acquisition and retention (Gould & Roberts, 1982; McCullagh, Weiss, & Ross, 1989).

Bandura's mediational-contiguity theory states that when a person observes a model, symbolic coding of what

is observed occurs in memory so that a cognitive representation of the modeled activity is formed. If modeling occurs before performance, learning is assumed to occur without active performance. Therefore, a person can rely on the cognitive representation as a guide to perform the activity, detect error, and employ error corrections.

The four subprocesses theorized to occur during observational learning of a motor skill include attention, retention, motor reproduction, and motivation (Carroll & Bandura, 1982, 1985, 1990). In the attention process, a modeled act is observed and information is conveyed to the learner. The retention process includes storing of information in memory (symbolic coding) which entails rehearsal, labeling, and organization of modeled information. In the motor reproduction process, the physical action is reproduced from the memory representation formed during retention. Finally, the motivation process is an important process because a student must be motivated to attend to and learn from a model and also continue motor reproduction.

Modeling of motor skills is commonly used by having students observe a demonstration of the movement pattern

involved in skill production, such as form used in the tennis serve, shooting a free-throw in basketball, or a dance step. Modeling only the movement pattern for these skills is sufficient as all the information needed by the learner to perform the skill is in a demonstration of only the movement pattern. But, for open skills that require a movement pattern to be adjusted to the perceptual demands present in the environment, such as returning an oncoming tennis volley or batting a pitched ball in baseball, a motor pattern demonstration may not be the most important information to relay to the learner. Instead, allowing the learner passive viewing experiences with an oncoming objects (perceptual modeling) prior to initiating practice of a movement pattern to be timed with the object has been shown by Weeks (1991) to be beneficial for acquisition of the entire skill. These skills are called coincident-timing skills. It is believed that perceptual modeling, like other forms of modeling, allows a learner to form a memory representation that can be cognitively rehearsed and organized as hypothesized by Bandura's mediational-contiguity theory.

While perceptual modeling has been shown to benefit acquisition of coincident-timing skills (Weeks, 1991), there is a question as to how much exposure to the stimulus is necessary to optimize initial performance. If more exposure to perceptual modeling is better than less exposure, then this supports an idea that the more information conveyed (i.e. more exposure to the model), the stronger and more well developed will be the central representation for the entire skill. Thus, more perceptual modeling would theoretically enhance what Bandura calls the retention process which would in turn enhance the motor reproduction process once it was initiated.

The purpose of this study was to explore whether a higher frequency of perceptual modeling would significantly decrease timing errors in coincident-timing performance compared to a lower frequency. It was hypothesized that a higher frequency would be superior to a lower frequency for timing accuracy, supporting the idea that more modeling is better because the cognitive representation would be better developed. Hence, high frequencies of perceptual modeling would provide an

important source of pre-practice information to enhance early coincident-timing skill performance.

### Method

#### Subjects

Forty-four right-handed female undergraduate students with minimal coincident-timing skill ability (low involvement in sports that require hand/eye coordination) were randomly assigned in equal numbers to one of four experimental groups.

#### Apparatus

Perceptual modeling and subsequent coincident-timing performance were conducted using a 3.75 meter lighted runway with 80, .5 centimeter lights embedded in the top surface of the runway at 4.5 centimeter distances. The runway was constructed so that lights were sequentially lit, simulating an object rapidly approaching the subject who was seated to the right of the runway. Before the lights were illuminated, subjects were required to press down a button 60 centimeters from a barrier which was parallel to the final runway light. The barrier was to be knocked over with the right hand at the same instant the last light on the runway was illuminated. Thus, a right to left arm motion was to be made from the start button

to the barrier coincident with the lighting of the runway lights. A millisecond clock was used to measure timing error, which was the time between the illumination of the final runway light and barrier knock-over.

#### Procedure

Eleven subjects, in four different groups, were tested in this experiment. Each group performed the identical task of depressing and releasing a button with their right hand and then making arm motions with their right arms from right to left knocking over the barrier. This was accomplished while the test subjects were in a seated position observing the lighted runway to the left. All groups were given verbal instruction as well as a physical demonstration of the movement by the experimenter prior to actual trials. Two practice trials were given to insure that participants understood verbal instructions and that the arm movement was properly executed. Subjects were then asked if the goal of the task was fully understood.

At this point, the protocol varied depending on the group to which a subject was assigned. One group, considered the control group, received no perceptual



modeling, but simply initiated active performance (No PM group).

The three remaining experimental groups received perceptual modeling for a given number of trials prior to active performance. While receiving perceptual modeling, subjects sat quietly with their hands in their laps and passively observed the runway lights. Subjects were encouraged to think of the arm motion that they would initiate during subsequent trials while visually judging the movement speed of the oncoming lights. The 10 PM group received ten perceptual modeling trials, the 5 PM group received five perceptual modeling trials, and the 1 PM group received a single perceptual modeling trial prior to active performance.

Subjects were tested at two different runway light speeds for twenty trials (536 and 670 cm/s) with all trials at one speed performed before performing at the other speed. Subjects in the modeling groups received modeling at each speed before actively performing the arm motion.

#### Data Analysis

Timing error (exactly how early or late the subject was in knocking over the barrier compared to the time the

final runway light was illuminated) was recorded on each trial. During data analysis, trials were grouped into blocks of four and an absolute constant timing error score computed for each of the five blocks in acquisition. These scores were analyzed with analysis of variance using groups, blocks, and speeds as factors.

#### Results

In Figures one and two, notice that the group receiving no perceptual modeling, (No PM Group), performed with higher absolute constant timing error than any of the groups receiving perceptual modeling at both speeds. Analysis of variance showed that this group differed significantly from the other groups,  $F(3,40)=3.57$ ,  $p=.025$ . However, none of the groups receiving modeling differed significantly from each other as indicated by Tukey tests.

#### Discussion

This study indicated that perceptual modeling was beneficial for coincident-timing skill acquisition, such as hitting or catching rapidly moving objects. Thus, it may be an important method for teaching practitioners to employ in addition to modeling of the movement pattern prior to practice.

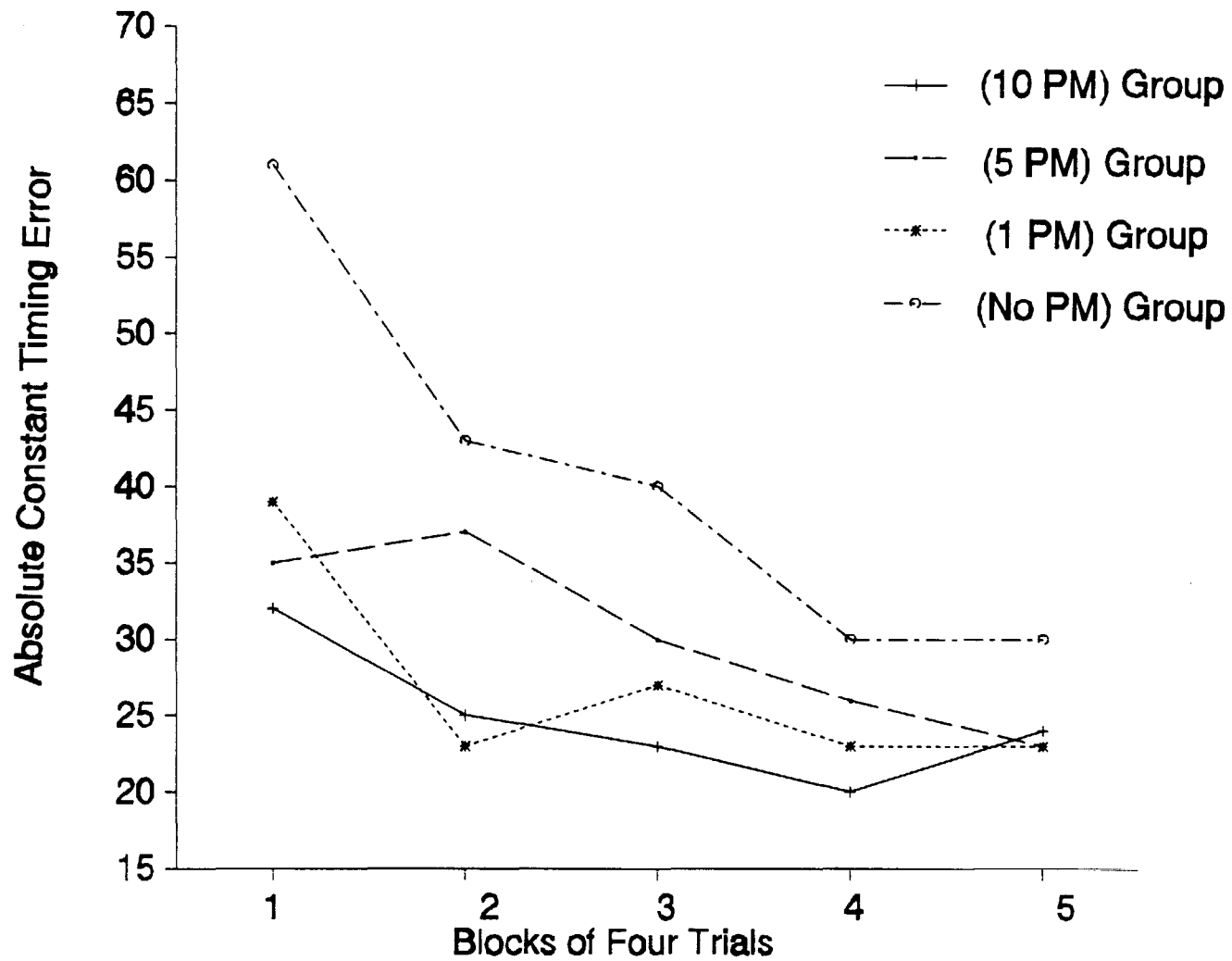


Figure 1. Absolute Constant Timing Error For Each Group in the 536 cm/s Condition

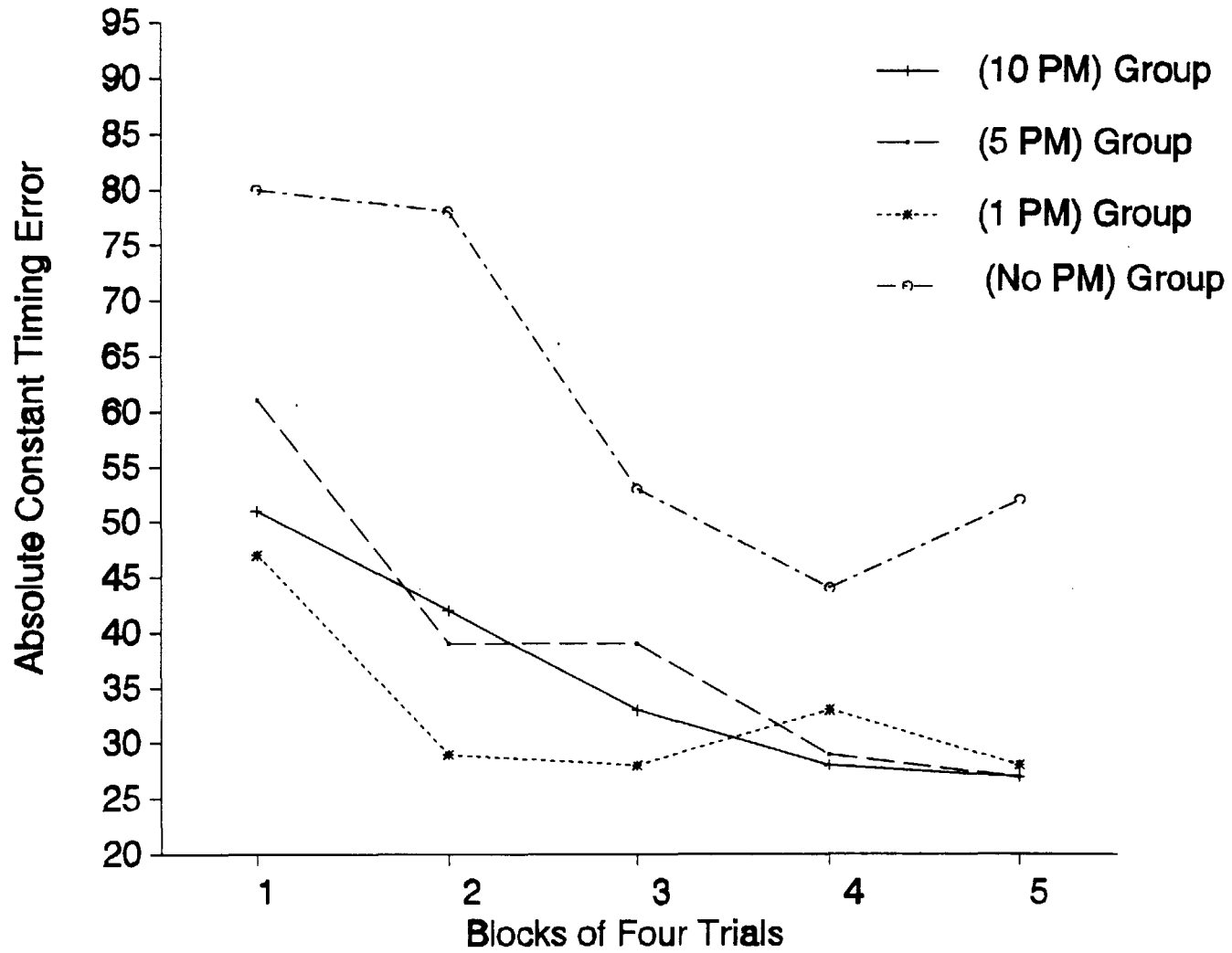


Figure 2. Absolute Constant Timing Error For Each Group in the 670 cm/s Condition

In terms of observational learning theory, it was concluded that perceptual modeling provided an important source of pre-practice information to enhance the retention phase and motor reproduction phase, once initiated.

Bandura's cognitive mediation theory (symbolic coding of what is observed) suggests that a memory representation, formed from observation, can be accessed to perform a skill (Magill, 1989). This representation serves as a guide for performance. Perceptual modeling, at any frequency allowed the learner to form a cognitive memory representation that enhanced the motor reproduction process.

Although in this study perceptual modeling was found beneficial, the hypothesis that an increased frequency of perceptual modeling would decrease error compared to limited exposure was not substantiated. This study failed to show that increased perceptual preview was more beneficial for motor reproduction.

Just one experience with the perceptual demands of the task seemed to prepare the information processing system for performing the entire task. Overall,

perceptual modeling was just as advantageous for subjects experiencing one perceptual modeling trial as it was for viewing ten trials.

It can be concluded that perceptual modeling is beneficial for tasks such as racquet and batting skills. There is no significant difference of perceptual modeling time except that at least one trial is highly beneficial for subsequent practice of the entire skill.

Instructors in sport and physical education have long accepted modeling as an acceptable method of demonstration for motor reproduction of coincident-timing skills such as batting a pitched ball or returning a volley in racquet sports. An additional component of demonstration, perceptual modeling, can be added to decrease timing error and consequently accelerate early acquisition due to an enhanced cognitive representation (Carroll & Bandura, 1990).

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