

A Comparison of the Contribution of Perceptual
Modeling and Knowledge of Results to
Coincident-timing Skill Acquisition

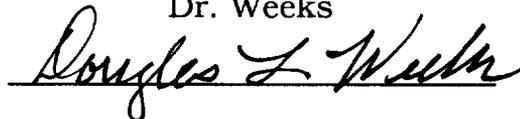
An Honors Thesis

by

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Dr. Weeks

A handwritten signature in cursive script that reads "Douglas L. Weeks". The signature is written in black ink and is positioned above a thin horizontal line.

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Abstract

While a few studies have compared the relative contribution of knowledge of results (KR) and modeling to learning of closed motor skills (e.g., McCullagh & Little, 1989; Ross, Bird, Doody, & Zoeller, 1985), the strength of each in contributing to open skill acquisition, specifically coincident-timing skill acquisition, is largely unexplored. Weeks (1991) has demonstrated that coincident-timing skill acquisition is accelerated if subjects receive pre-practice modeling with the perceptual demands of the task. Specifically, subjects passively viewing stimulus runway lights on a Bassin anticipation timer were more accurate on initiation of active practice than subjects simply initiating practice with KR. In these experiments, the groups receiving perceptual modeling also received KR; therefore, the relative contribution of modeling independent of KR is unknown. This study compared the contribution of perceptual modeling independent of KR in learning a coincident-timing task. Subjects (n=48) were randomly assigned to one of four groups: a modeling+KR group, a modeling only group, a KR only group, or a no modeling/no KR group. A Bassin timing apparatus was used to provide perceptual modeling and support measurement of

coincident-timing ability. The task consisted of a 60 cm right-to-left arm motion to knock over a barrier coincident with the lighting of the final light on the stimulus runway. Groups receiving modeling viewed the lights ten times prior to the initiation of twenty active practice trials, while groups given KR (in ms early or late in displacing the barrier) received it after each trial. Results indicated that groups receiving perceptual modeling initiated practice with less absolute constant error (ACE) than the KR only group. However, the KR only group was more accurate later in practice than the group receiving only perceptual modeling. The no KR/no modeling group performed with significantly less accuracy throughout acquisition than any other group. It was concluded that perceptual modeling is relatively more important than KR early in practice, but was not sufficient to encourage improvement in mid to late acquisition. Instead, KR appears to be relatively more important than modeling in this stage of acquisition. Overall, optimal conditions for skill acquisition seem to arise when perceptual modeling is used in combination with KR.

Introduction

In recent years, two variables that have been the focus of much research in motor behavior are pre-practice modeling of a skill to be learned, and feedback provided to the learner during practice, commonly referred to as knowledge of results (KR). The interest in these variables is primarily due to each variable's ability to accelerate motor skill acquisition. Studies have confirmed that KR is a very powerful variable in optimizing skill acquisition (Samoni, Schmidt, and Walter, 1984). While only a few studies have compared the relative contribution of KR and modeling to learning of closed motor skills (e.g., McCullagh & Little, 1989; Ross, Bird, Doody, & Zoeller, 1985), the strength of each in contributing to open skill acquisition has only recently been explored by Weeks (1991). In this study, a group of subjects receiving a special form of modeling termed perceptual modeling and KR was compared to a group of subjects receiving only KR. In perceptual modeling subjects view the external stimulus, this is different from motoric modeling in which subjects view the skill being performed. While the group receiving modeling initially out-performed the group receiving only KR, the group receiving only KR eventually performed

similarly to the group receiving modeling and KR. Thus the beneficial effects of modeling were most prominent early in learning, but during active practice, the powerful effect of KR took over, thereby, masking any earlier advantage due to modeling alone. Because a group was not included which received modeling only, it was not clear whether modeling, like KR, alone could be sufficient to support continued improvement in acquisition. In addition, it was not clear which of the two variables, modeling or KR, was most beneficial to learning. Thus, it was the purpose of this study to establish the relative contribution that perceptual modeling made to open skill acquisition in order to contrast the effects of modeling and KR separately, as it has been done for closed skills (McCullagh & Little, 1989; Ross et al., 1985). The motor skill employed involved visually tracking a rapidly paced, external stimulus while performing a rapid arm movement to time the arrival of the external stimulus at a particular point in time and space. Based upon the coincidence between the arrival of the stimulus at a particular location and the timing of the arm movement, electronic clocks allowed the determination of timing error as a measure of performance improvement. These skills are

commonly referred to as coincident-timing skills. The timing-error in the form of milliseconds early or late, was used as KR for subjects in a group designated to receive KR. Subjects in groups designated to receive perceptual modeling received it prior to acquisition by viewing the external stimulus ten times.

Method

Subjects

Forty-eight right-handed, undergraduate female volunteers from physical education activity classes served as subjects in the study. Each subject was randomly assigned to one of four groups, thus each group consisted of 12 subjects.

Apparatus

A Bassin timing apparatus, consisting of a 3.75 meter lighted runway with 80, .5 cm lights imbedded in the top surface at 4.5 cm distances, was used to provide the modeling experiences and subsequently measure timing performance. The runway was constructed so that the lights could be sequentially lit, thereby simulating an object rapidly approaching the seated subject. As the lights were sequentially lit, appearing to move toward the subject from the left, the subjects moved their right arm from right to left through a 60 cm distance to knock over a

barrier at the same time that the last light on the runway was lit. The modeling and actual practice took place with lights appearing to move at 15 mph. Before the lights started, the subjects signaled they were ready to begin a trial by pressing down a start button 60 cm from the barrier. They kept it pressed down until the lights were illuminated. After the sequence of lights was started, the button was released and the movement toward the barrier was made with the goal being to knock over the barrier as the final runway light was lit. A clock measured the amount of time in milliseconds between the lighting of the final light and when the subject knocked over the barrier. This information, called timing error, served as KR during practice, and was the measure of performance analyzed in data analysis as an indicator of performance improvement.

Procedure

There were four groups in this experiment. The first group received perceptual modeling and KR. The modeling was provided by allowing the subject to passively view the speed of the lights prior to initiating practice. During the modeling trials, the subjects were only to watch the lights and make no arm movement. The subject were given 10 chances to view the

approaching lights before initiating practice with KR. The second group received perceptual modeling but no KR. The third group received no perceptual modeling but got KR during practice. The final group received neither modeling nor KR, and thus served as a control group. Each subject performed twenty acquisition trials at 15 mph. KR, in the form of milliseconds of error, was given to appropriate groups following each of the twenty trials. After the twenty acquisition trials, all groups performed another eight trials in a retention test in which none of the groups received KR.

Data Analysis

Timing error scores were grouped into blocks of four trials resulting in five acquisition blocks and two retention blocks. Constant error and variable error were determined for each block of trials for each subject to eliminate the possibility that constant error scores for subjects within a group could cancel each other out due to opposite signs. All constant error scores were converted to absolute values prior to obtaining a group average for each block. Absolute constant error and variable error were analyzed in separate analyses of variance with groups and blocks as factors. Type I error rate was established at $p=.05$.

Results

Absolute Constant Error

Analysis of ACE data showed main effects for group, $F(3,44)=4.55$, $p=.007$ and block, $F(4,176)=13.79$, $p<.001$. ACE score for each group are displayed in Figure 1 and Table 1. Note that the groups performing with least error on initiation of practice were the groups receiving modeling. The group receiving KR only, while initiating practice at a higher level of error than either modeling group, performed relatively equally to the modeling plus KR group by the second block of trials. The group receiving modeling only initially performed similarly to the modeling plus KR group, but by the second block of trials was at a significantly higher level of error.

Insert Figure 1 and Table 1 about here

Variable Error

Analysis of VE data showed main effects for group, $F(3,44)=3.02$, $p=.040$ and block, $F(4,176)=2.95$, $p=.022$. As seen in Figure 2 and Table 2, the KR only group initiated practice with the least variability from trial-to-trial, followed by each of

the modeling groups. Note, however, that by blocks two and three, the modeling plus KR group displayed the most stable performance, indicating that large trial-to-trial adjustments were not necessary to maintain accuracy. While the KR only group was initially the least variable, by blocks two and three the group remained at about the same variability. Note that even though the modeling only group initially was more variable, by blocks two and three the group performed similarly to the KR only group.

Insert Figure 2 and Table 2 about here

Discussion

The results of this experiment indicated that while all groups improved over the acquisition trials, the groups receiving KR improved CE rapidly while the groups receiving no KR improved slowly and not to the same degree. The addition of the group receiving only perceptual modeling showed that modeling is only slightly more important than KR early in practice, but was not sufficient enough to cause improvement in mid to late practice. The groups receiving KR, on the other

hand, became more accurate as practice continued, thus showing that KR is more effective in increasing accuracy than perceptual modeling.

When looking at VE, the group receiving perceptual modeling had a relatively higher variability in the first block than did the group receiving KR only. This suggests that although perceptual modeling helps CE, it may cause the subjects to become more variable about the mean. Although perceptual modeling only slightly aided accuracy early in the acquisition phase and KR was significantly more important in the mid to late stages of acquisition, the optimal conditions for coincident-timing skill acquisition seems to be perceptual modeling used in conjunction with KR.

References

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Table 1

Absolute Constant Error for each Group

Groups	Blocks				
	1	2	3	4	5
MOD+KR	92.4	57.5	40.9	42.3	35.3
KR only	102.2	61.0	35.2	37.3	36.4
MOD only	93.4	85.0	82.7	75.5	82.6
NO MOD/KR	132.4	123.2	104.8	98.2	95.5

Table 2

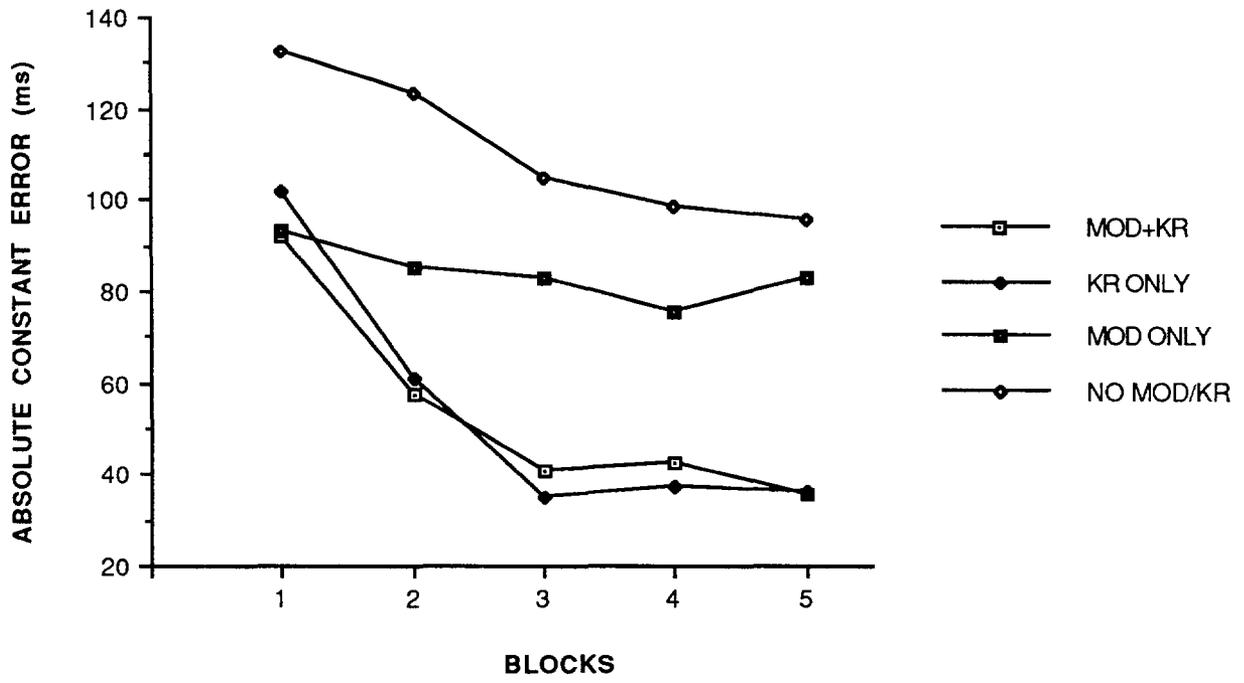
Variable Error for each Group

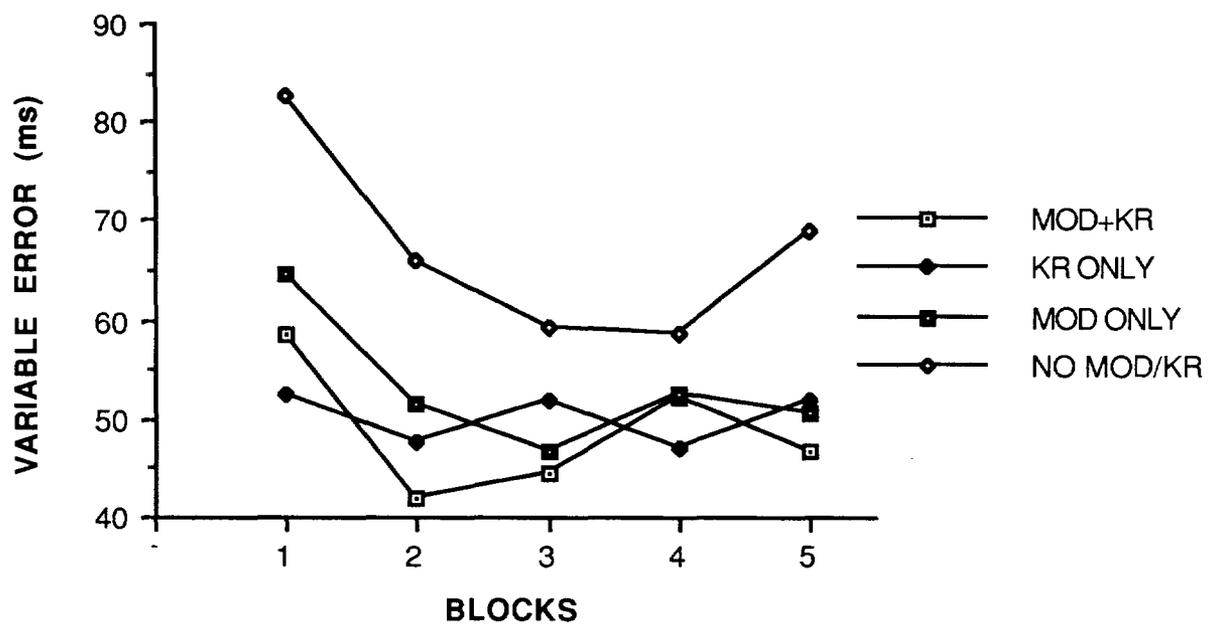
Groups	Blocks				
	1	2	3	4	5
MOD+KR	58.7	42.0	44.5	52.1	46.8
KR only	52.6	47.8	52.0	47.1	52.0
MOD only	64.8	51.6	46.6	52.6	50.7
NO MOD/KR	82.6	66.1	59.3	58.5	68.9

Figure Caption

Figure 1. Absolute Constant Error for Each Group

Figure 2. Variable Error for Each Group





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Dear Colleague:

Congratulations! Your abstract has been accepted for oral presentation in one of the free communication sessions sponsored by the Research Consortium during the 1991 AAHPERD National Convention in Indianapolis. Your abstract will be included in the Research Quarterly for Exercise and Sport Supplement to be published and distributed to all subscribers early in 1992 prior to the convention. The RQES Supplement will also be on sale in the AAHPERD publication booth at the convention.

To enhance the quality of the free communication sessions please review the following suggestions as you plan your presentation:

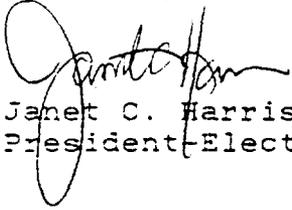
1. Plan your presentation for 10 minutes. (You will be cut off at the end of 12 minutes to allow time for questions.)
2. Prepare slides or overhead transparencies with care:
 - a. Slides should emphasize the important points. (Usually you do not need a slide that repeats exactly what you plan to state orally.)
 - b. Individual slides should convey a limited amount of information (e.g., a large correlation matrix or a complex ANOVA table may be more distracting than useful in communicating to an audience in a short presentation).
 - c. Use large letters, numbers, and figures (large enough to be read easily from the back of a large classroom).
3. Prepare your presentation so that it will require a minimum of reading from a prepared text. (Perhaps the use of slides to key important points would be helpful).
4. Practice your talk to ensure effective oral communication within the time limit.
5. Arrive at the assigned room at least fifteen minutes prior to the beginning of the session. Introduce yourself to the presider. Arrange your slides in the projector and preview them to ensure that they are in the appropriate sequence.

6. It is common collegial courtesy that all presenters are present for the entire session in which they are presenting. Moreover, often those in attendance have extensive questions that they may wish to ask presenters following the session.

Enclosed you will find a program sheet that includes the date and time of your presentation. To ensure that we have an accurate program, please assist us by carefully proofreading the titles, name(s) and institutional affiliation(s). If there are any errors, or if you cannot present the study, please contact me immediately. Also, please remember that membership in AAHPERD as well as convention registration are requirements for presentation.

Again, congratulations! I look forward to a very successful Research Consortium program in Indianapolis due to contributions such as yours. Lastly, please consider submitting your research for publication in the Research Quarterly for Exercise and Sport.

Sincerely,



Janet C. Harris
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